SOUTHERN ENVIRONMENTAL LAW CENTER

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NASHVILLE, TN 37203

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November 7, 2017

VIA FOIAonline (foiaonline.regulations.gov) and U.S. MAIL

Gayla Mendez
Regional Freedom of Information Officer
U.S. EPA, Region 4
AFC Bldg., 61 Forsyth Street, S.W., 9th Flr. (4PM/IF)
Atlanta, GA 30303-8960

Re: Freedom of Information Act Request: 1976 Thermal Variance for TVA Kingston NPDES Permit (TN0005452) and Supporting Biological Studies.

Dear Ms. Mendez:

Under the Freedom of Information Act ("FOIA"), 5 U.S.C. § 552, as amended, the Southern Environmental Law Center ("SELC") requests the following documents:

1. The April 1976 Environmental Protection Agency ("EPA") thermal variance determination referred to on page R-33 of the Tennessee Department of Environmental Conservation's ("TDEC") draft National Pollutant Discharge Elimination System ("NPDES") renewal permit for the Tennessee Valley Authority's ("TVA") Kingston Fossil Plant ("KIF") (Attachment A): "In previous NPDES permits, TVA has provided information to support its request that a daily maximum condenser cooling water discharge temperature limitation of 36.1°C (97°F) be allowed under Section 316(a) of the Act. ***Since EPA issued it in 1976***, NPDES permits have allowed alternative limitations on the thermal component of the facilities' condenser cooling water discharge . . . .";

2. The following 1973–1975 biological studies referred to on page 1 of TVA's *Biological Monitoring of the Clinch River Near Kingston Fossil Plant Discharge, Autumn 2015* submitted as part of its NPDES renewal application for KIF (Attachment B): "Prior to 2001, the Tennessee Valley Authority's (TVA) Kingston Fossil Plant (KIF) was operating under an [alternative thermal limitation] that had been continued with each permit renewal ***based on studies conducted in the mid-1970s***."[1]

For the purposes of this request, the term "documents" includes all written, printed, recorded or electronic: materials, communications, correspondence, emails, memoranda,

[1] These documents are also described in the attached fact sheet from TDEC (Attachment C).

notations, copies, diagrams, charts, maps, photographs, tables, spreadsheets, formulas, directives, observations, impressions, contracts, letters, messages and mail in the possession or control of the Environmental Protection Agency.

FOIA requires a responding agency to make a "determination" on any request within twenty (20) working days of receipt. *See* 5 U.S.C. § 552(a)(6)(A)(i). The statute favors disclosure of records and instructs the agency to withhold information only in narrowly defined circumstances in which the agency can articulate a reasonably foreseeable harm protected by an exemption. *See id*. at § 522(a)(8)(A)(i). FOIA also requires the release of all reasonably segregable portions of a document that are themselves not exempt. *Id.* § 552(b). Should the EPA deny this request, the EPA must inform SELC of the grounds for denial and the specific administrative appeal rights which are available. *See Id.* § 552(a)(6)(A)(i).

SELC is requesting photocopies without charge, or at a reduced charge, because reduction or waiver of fees would be in the public interest. A disclosure is in the public interest if (1) it is likely to contribute significantly to public understanding of the operations or activities of the government, and (2) it is not primarily in the commercial interest of the requester. The public interest standard of the fee waiver provision of the FOIA should be "liberally construed" in favor of waivers. *McClellan Ecological Seepage Situation v. Carlucci*, 835 F.2d 1282, 1284 (9th Cir. 1987); *Pederson v. Resolution Trust Corp.*, 847 F. Supp. 851, 855 (D. Colo. 1994); *Etlinger v. FBI*, 596 F. Supp 867, 872 (D. Mass. 1984). The goal of the statute is to avoid the "roadblocks and technicalities which have been used by various Federal agencies to deny waivers." *Pederson*, 847 F. Supp. at 855.

SELC is a 501(c)(3) non-profit organization with over thirty (30) years of experience disseminating public information regarding EPA regulatory and operations issues. *See* 5 U.S.C. § 552(a)(4)(A)(iii). SELC maintains a website that includes both general and topic-specific information regarding the matters with which SELC is involved, including matters related to water pollution at TVA coal plants.[2] Lawyers at SELC are interviewed by or otherwise provide information to the media to explain their work related to water pollution at TVA coal plants and its significance.[3] SELC's website contains documents generated by SELC for the specific purpose of educating the public on particular issues. SELC speaks at community meetings on particular topics, including water pollution at TVA coal plants. SELC also assists the public in

[2] *See, e.g.* https://www.southernenvironment.org/news-and-press/news-feed/administration-tells-power-plants-they-can-keep-polluting-water (April 2017); https://www.southernenvironment.org/news-and-press/news-feed/tva-refuses-to-disclose-water-quality-data-from-leaking-gallatin-coal-ash-s (January 2017); https://www.southernenvironment.org/news-and-press/news-feed/lawsuit-threatened-against-tva-for-known-violations-at-leaky-cumberland-fos (January 2016).

[3] *See, e.g.*, https://www.nytimes.com/2017/04/15/climate/tennessee-coal-ash-disposal-lawsuits.html?_r=0 (April 15, 2017); http://www.tennessean.com/story/opinion/2017/05/22/time-tva-state-regulators-step-up/101480930/ (May 22, 2017).

locating information relating to a particular topic by collecting and posting relevant information, documents, and links to other websites.[4]

Both TVA and EPA are government actors, and the information requested by SELC is not already available in the public domain to our knowledge.

A fee waiver will benefit the general public through increased notice and understanding of the operations of the government and of potential or proposed major policy incentives. SELC further certifies that disclosure of the information sought is not in our commercial interest.

Should SELC's request for reduced or waived fees be denied, SELC is prepared to bear the reasonable duplication and search costs necessary to fulfill this request. However, I request you contact me before processing this request if the fee is expected to be in excess of $100.00. SELC reserves its right to appeal a fee waiver or reduction denial.

If you have any questions regarding this request, please feel free to contact me at (615)921-9470 or creichert@selctn.org. I appreciate your prompt attention to this matter and look forward to receiving the public records requested.

Sincerely,

Christina Reichert

[4] *See, e.g.*, https://www.southernenvironment.org/news-and-press/press-releases/drinking-water-supplies-for-over-2-million-people-in-tennessee-at-risk-unde; https://www.southernenvironment.org/uploads/words_docs/TVAServiceArea_and_CoalPlants_and_DWintakes_2016_0630_final.pdf.

ATTACHMENT A

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DIVISION OF WATER RESOURCES
William R. Snodgrass - Tennessee Tower
312 Rosa L. Parks Avenue, 11th Floor
Nashville, Tennessee 37243-1102

October 31, 2017

Mr. Terry Cheek
Senior Manager, Water Permits, Compliance and Monitoring
e-copy: techeek@tva.gov
Tennessee Valley Authority
1101 Market Street BR 4A-C
Chattanooga, TN 37402

Subject: **Draft of NPDES Permit No. TN0005452**
TVA - Kingston Fossil Plant (KIF)
Harriman, Roane County, Tennessee

Dear Mr. Cheek:

Enclosed please find a draft copy of the NPDES Permit No. TN0005452, which the Division of Water Resources proposes to issue. This draft copy is furnished to you solely for your review of its provisions. No wastewater discharges are authorized by this draft permit. The issuance of this permit is contingent upon your meeting all of the requirements of the Tennessee Water Quality Control Act and the Rules and Regulations of the Tennessee Water Quality, Oil and Gas Board.

Also enclosed is a copy of the public notice that announces our intent to issue this permit. The notice affords the public an opportunity to review the draft permit and, if necessary, request a public hearing on this issuance process. If you disagree with the provisions and requirements contained in the draft permit, you have thirty (30) days from the date of this correspondence to notify the division of your objections. If your objections cannot be resolved, you may appeal this permit upon issuance. This appeal should be filed in accordance with Section 69-3-110 of the Tennessee Code Annotated.

If you have questions, please contact the Knoxville Environmental Field Office at 1-888-891-TDEC; or, at this office, please contact Mr. Bob Alexander at (615) 532-0659 or by E-mail at *Robert.Alexander@tn.gov*.

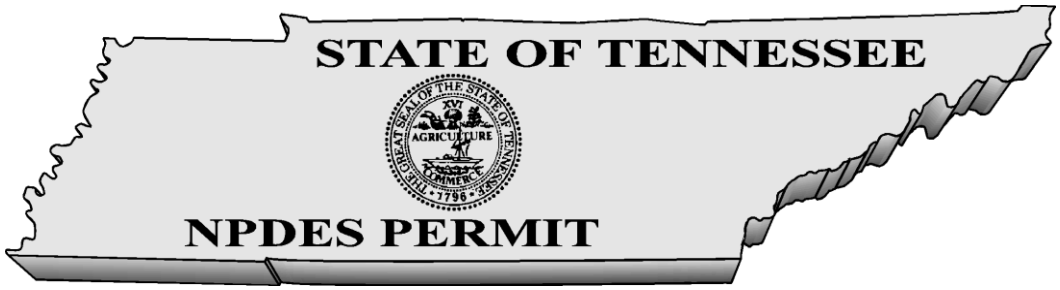
Sincerely,

Vojin Janjić
Manager, Water-Based Systems

Enclosure

cc: Permit Section File & Knoxville Environmental Field Office
EPA Region 4, r4permits@epa.gov
Mr. Steve Alexander, US Fish and Wildlife Service, steven_alexander@fws.org
Ms. Abigail Dillen, Staff Attorney, Earthjustice, adillen@earthjustice.org
Mr. Scott Gregory, Chariman, Roane County Advisory Board, , scotttn1@juno.com
Mr. Mark Quarles, P.G., Global Environmental Consultants, LLC, markquarles@comcast.net
Mr. Abel Russ, Attorney, Environmental Integrity Project, aruss@environmentalintegrity.org
Mr. Brian Paddock, Attorney, Save Our Cumberland Mountains (SOCM), bpaddock@twlakes.net
Ms. Dana L. Wright, Director of Policy and Legislative Affairs, TCWN, dana@tcwn.org
Ms. Karrie-Jo Robinson Shell, Environmental Engineer, US EPA Region 4, shell.karrie-jo@epa.gov
Mr. Peter Melale, , shasop373@gmail.com

Ms. Allison Fay, President, WASI, afay@wasi.net
Ms. Mary Anne Koltowich, Recorder, , kolsmithma@gmail.com
Ms. Lisa Widawsky, Attorney, Environmental Integrity Project, lwidawsky@environmentalintegrity.org
Mr. David K. Beverly, Consulting Engineer, , copperridge303@bellsouth.net
Ms. Providence M. Spina, Associate, Crowell & Moring LLP, pspina@crowell.com
Ms. Amanda Garcia, Staff Attorney, SELC, agarcia@selctn.org
Mr. Chuck Head, TDEC, Chuck.Head@tn.gov
Ms. Bonnie Swinford, Board Member, United Mountain Defense, bswinford1@yahoo.com
Ms. Gail Okulczyk, Chair, Roane County Environmental Review Board, gailokul@gmail.com



No. TN0005452

Authorization to discharge under the
National Pollutant Discharge Elimination System (NPDES)
Issued By

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DIVISION OF WATER RESOURCES
William R. Snodgrass - Tennessee Tower
312 Rosa L. Parks Avenue, 11th Floor
Nashville, Tennessee 37243-1102

Under authority of the Tennessee Water Quality Control Act of 1977 (T.C.A. 69-3-101 et seq.) and the delegation of authority from the United States Environmental Protection Agency under the Federal Water Pollution Control Act, as amended by the Clean Water Act of 1977 (33 U.S.C. 1251, et seq.)

Discharger: **TVA – Kingston Fossil Plant**

is authorized to discharge: **treated ash pond effluent consisting of bottom ash transport water, coal yard runoff including coal storage area drainage, utility building area drainage, and fire protection flushes; combustion residual leachate; chemical and nonchemical metal cleaning wastes; ammonia storage area runoff; water treatment plant wastes including RO system reject and backwash; drainage from sluice line trench; station sump discharge including ash system leakage and boiler bottom overflow and fan bearing cooling water, equipment cooling and lubricating water, fire protection flushes, floor washing, roof drains and precipitator washdown, boiler water leakage, analytical process wastewater, basement boiler blowdown, and lab sample stations; stormwater from FGD area sump; and AAF area sump with precipitator wash and raw water leakage from Outfall 001; once-through condenser cooling water discharge plus flows from Outfall 001; boiler blowdown; discharge from underflow ponds with fire protection flushes, raw water leakage and transformer/switchyard runoff; intake screen backwash from Outfall 004 and FGD strainers; discharge from FGD stormwater pond IMP 01A; and emergency overflow from pond at FGD dewatering facility an/landfill area only in probable maximum precipitation event, and discharge from Outfall 006 from Outfall 002; and operation of a cooling water intake structure**

from a facility located: **in Harriman, Roane County, Tennessee**
to receiving waters named: **Clinch River mile 2.9**

in accordance with effluent limitations, monitoring requirements and other conditions set forth herein.

This permit shall become effective on:
This permit shall expire on:
Issuance date:

for Tisha Calabrese Benton
Director

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PART I - EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

TVA-Kingston Fossil Plant is authorized to discharge to Clinch River at mile 2.9:

Location	Characteristics
Outfall 001	treated ash pond effluent consisting of bottom ash transport water, coal yard runoff including coal storage area drainage, utility building area drainage, and fire protection flushes; combustion residual leachate; chemical and nonchemical metal cleaning wastes; ammonia storage area runoff; water treatment plant wastes including RO system reject and backwash; drainage from sluice line trench; station sump discharge including ash system leakage and boiler bottom overflow and fan bearing cooling water, equipment cooling and lubricating water, fire protection flushes, floor washing, roof drains and precipitator washdown, boiler water leakage, analytical process wastewater, basement boiler blowdown, and lab sample stations; stormwater from FGD area sump; and AAF area sump with precipitator wash and raw water leakage
Outfall 002	once-through condenser cooling water discharge plus flows from Outfall 001; boiler blowdown; discharge from underflow ponds with fire protection flushes, raw water leakage and transformer/switchyard runoff; intake screen backwash from Outfall 004 and FGD strainers; discharge from FGD stormwater pond IMP 01A; and discharge from Outfall 006
Outfall 004	Intake screen backwash (raw river water)
Outfall 006	Elec. Control bldg. AC condensate, fire protection flushes, and plant water leakage
IMP 01A	Pond at FGD dewatering facility and combustion residual leachate from peninsula area FGD and ash landfill
Outfall 01B	Emergency overflow from pond at FGD/landfill only during probable maximum precipitation event
I**MP 005**	Metal Cleaning wastewater

These discharges shall be limited and monitored by the permittee as specified below:

OUTFALL 001

1. I**NTERIM** Permit requirements applicable upon the permit Effective Date.

Code	Parameter	Qualifier	Value	Unit	Sample Type	Frequency	Statistical Base
00400	pH	>=	6.0	SU	Grab	Weekly	Minimum
00400	pH	<=	9.0	SU	Grab	Weekly	Maximum
00530	Total Suspended Solids (TSS)	<=	100	mg/L	Grab	Monthly	Daily Maximum
00530	Total Suspended Solids (TSS)	<=	30	mg/L	Grab	Monthly	Monthly Average
00556	Oil & Grease	<=	20	mg/L	Grab	Monthly	Daily Maximum
00556	Oil & Grease	<=	15	mg/L	Grab	Monthly	Monthly Average
01002	Arsenic, total (as As)	Report	-	mg/L	Grab	Monthly	Daily Maximum
01007	Barium, total (as Ba)	Report	-	mg/L	Grab	Monthly	Daily Maximum
01012	Beryllium, total (as Be)	Report	-	mg/L	Grab	Monthly	Daily Maximum
01027	Cadmium, total (as Cd)	Report	-	mg/L	Grab	Monthly	Daily Maximum
01034	Chromium, total (as Cr)	Report	-	mg/L	Grab	Monthly	Daily Maximum
01042	Copper, total (as Cu)	Report	-	mg/L	Grab	Monthly	Daily Maximum
01045	Iron, total (as Fe)	Report	-	mg/L	Grab	Monthly	Daily Maximum
01051	Lead, total (as Pb)	Report	-	mg/L	Grab	Monthly	Daily Maximum
01059	Thallium, total (as Tl)	Report	-	mg/L	Grab	Monthly	Daily Maximum
01067	Nickel, total (as Ni)	Report	-	mg/L	Grab	Monthly	Daily Maximum
01077	Silver, total (as Ag)	Report	-	mg/L	Grab	Monthly	Daily Maximum
01092	Zinc, total (as Zn)	Report	-	mg/L	Grab	Monthly	Daily Maximum
01097	Antimony, total (as Sb)	Report	-	mg/L	Grab	Monthly	Daily Maximum
01105	Aluminum, total (as Al)	Report	-	mg/L	Grab	Monthly	Daily Maximum
01147	Selenium, total (as Se)	Report	-	mg/L	Grab	Monthly	Daily Maximum
50050	Flow	Report	-	Mgal/d	Instantaneous	Weekly	Monthly Average
50050	Flow	Report	-	Mgal/d	Instantaneous	Weekly	Daily Maximum
	Fluoride	Report	-	mg/L	Grab	Monthly	Daily Maximum
	Boron	Report	-	mg/L	Grab	Monthly	Daily Maximum
	Calcium	Report	-	mg/L	Grab	Monthly	Daily Maximum
	Sulfate	Report	-	mg/L	Grab	Monthly	Daily Maximum
	Total Dissolved Solids	Report	-	mg/L	Grab	Monthly	Daily Maximum
	Antimony	Report	-	mg/L	Grab	Monthly	Daily Maximum
	Cobalt	Report	-	mg/L	Grab	Monthly	Daily Maximum
	Lithium	Report	-	mg/L	Grab	Monthly	Daily Maximum
	Molybdenum	Report	-	mg/L	Grab	Monthly	Daily Maximum
	Thallium	Report	-	mg/L	Grab	Monthly	Daily Maximum
	Ra^{228} and Ra^{229}	Report	-	mg/L	Grab	Monthly	Daily Maximum

2. **FINAL** Permit requirements include the Interim Permit Limits, as well as limitations for bottom ash transport water which are applicable December 1, 2023, as follows, pending modifications to 40 CFR Part 423 by EPA:

Bottom ash transport water. Except for those discharges to which paragraph 40 CFR 423.13 (k)(2) applies, or when the bottom ash transport water is used in the FGD scrubber, **there shall be no discharge of pollutants in bottom ash transport water**.

OUTFALL 002 – CONDENSER COOLING WATER

TDEC will extend the thermal variance of 36.1 degrees C in the renewed permit.

Description : External Outfall, Number : 002, Monitoring : Effluent Gross, Season : All Year

Code	Parameter	Qualifier	Value	Unit	Sample Type	Frequency	Statistical Base
00010	Temperature	<=	36.1	deg C	Calculated – see note	Daily	Daily Maximum
50050	Flow	Report	-	Mgal/d	Pump Log	Daily	Daily Maximum
50050	Flow	Report	-	Mgal/d	Pump Log	Daily	Monthly Average
71900	Mercury, total (as Hg)	<=	51	ng/L	Grab	Monthly	Daily Maximum
TRP3B	IC25 Static Renewal 7 Day Chronic Ceriodaphnia	>=	100	%	Composite	Annual	Minimum
TRP6C	IC25 Static Renewal 7 Day Chronic Pimephales	>=	100	%	Composite	Annual	Minimum

Description : External Outfall, Number : 002, Monitoring : Intake from Stream, Season : All Year

Code	Parameter	Qualifier	Value	Unit	Sample Type	Frequency	Statistical Base
00010	Temperature	Report	-	deg C	Recorder – see note	Continuous – see note.	Daily Maximum

Description : External Outfall, Number : 002, Monitoring : See Comments, Season : All Year

Code	Parameter	Qualifier	Value	Unit	Sample Type	Frequency	Statistical Base
34044	Oxidants, total residual	<=	.011	mg/L	Grab	Weekly	Monthly Average
34044	Oxidants, total residual	<=	.019	mg/L	Grab	Weekly	Daily Maximum

Temperature Reporting: Monitoring procedures: Intake temperature is measured hourly (continuously) but reported as a daily average once per day. The daily average discharge temperature shall be calculated for the cooling channel based on the 24-hour average intake temperature, 24-hour average unit load, and the 24-hour average flow through Outfall 002.

Total Residual Oxidant (TRO) monitoring shall be applicable when chlorine, bromine, or any other oxidants are added to the condenser cooling water. The acceptable methods for analysis of TRC are any methods specified in 40 CFR, Part 136. The Method Detection Level (MDL) for TRC shall not exceed 0.05 mg/l unless the permittee demonstrates that its MDL is higher. The permittee shall retain the documentation that justifies the higher MDL, and shall have that documentation available for review upon request. In cases where the permit limit is less than the MDL, the reporting of TRC at less than the MDL shall be interpreted to constitute compliance with the permit limit.

In the event that the background concentration of mercury in the Clinch/Emory River exceeds 51 ng/L (as measured at the intake) and the discharge from Outfall 002 does not contribute to additional loading in the receiving stream the permittee is not in violation of the permit. In such instances, TVA shall submit laboratory reports for intake mercury concentration for the associated discharge sample demonstrating elevated background mercury concentration.

OUTFALL 004 – INTAKE SCREEN BACKWASH

No numeric limits or reporting requirements are established; discharges of intake screen backwash are limited to material present in the raw water source.

OUTFALL 006 – ELECTRICAL BUILDING CONDENSATE AND MISCELLANEOUS DISCHARGES

No numeric limits or reporting requirements are established.

IMP 01A – PROCESS WATER BASIN AT FGD DEWATERING AND LANDFILL WASTEWATER

1. **INTERIM** Permit requirements applicable upon the permit Effective Date.

Description : External Outfall, Number : 01A, Monitoring : Effluent Gross, Season : All Year

Code	Parameter	Qualifier	Value	Unit	Sample Type	Frequency	Statistical Base
00400	pH	>=	6.0	SU	Grab	Weekly	Minimum
00400	pH	<=	9.0	SU	Grab	Weekly	Maximum
00530	Total Suspended Solids (TSS)	<=	100	mg/L	Grab	Monthly	Daily Maximum
00556	Oil & Grease	<=	20	mg/L	Grab	Monthly	Daily Maximum
71900	Mercury, total (as Hg)	Report	-	ng/L	Grab	Monthly	Daily Maximum
50050	Flow	Report	-	MGD	Instantaneous	Weekly	Monthly Average
50050	Flow	Report	-	MGD	Instantaneous	Weekly	Daily Maximum
	Boron	Report	-	ug/L	Instantaneous	Quarterly	Daily Maximum
	Calcium	Report	-	ug/L	Instantaneous	Quarterly	Daily Maximum
	Chloride	Report	-	ug/L	Instantaneous	Quarterly	Daily Maximum
	Fluoride	Report	-	ug/L	Instantaneous	Quarterly	Daily Maximum
	Sulfate	Report	-	ug/L	Instantaneous	Quarterly	Daily Maximum
	Total Dissolved Solids	Report	-	ug/L	Instantaneous	Quarterly	Daily Maximum
	Antimony	Report	-	ug/L	Instantaneous	Quarterly	Daily Maximum
	Arsenic	Report	-	ug/L	Instantaneous	Quarterly	Daily Maximum
	Barium	Report	-	ug/L	Instantaneous	Quarterly	Daily Maximum

	Beryllium	Report	-	ug/L	Instantaneous	Quarterly	Daily Maximum
	Cadmium	Report	-	ug/L	Instantaneous	Quarterly	Daily Maximum
	Chromium	Report	-	ug/L	Instantaneous	Quarterly	Daily Maximum
	Cobalt	Report	-	ug/L	Instantaneous	Quarterly	Daily Maximum
	Lead	Report	-	ug/L	Instantaneous	Quarterly	Daily Maximum
	Lithium	Report	-	ug/L	Instantaneous	Quarterly	Daily Maximum
	Molybdenum	Report	-	ug/L	Instantaneous	Quarterly	Daily Maximum
	Selenium	Report	-	ug/L	Instantaneous	Quarterly	Daily Maximum
	Thallium	Report	-	ug/L	Instantaneous	Quarterly	Daily Maximum
	Radium 226 and 228 combined	Report	-	ug/L	Instantaneous	Quarterly	Daily Maximum

2. **FINAL** Permit requirements (include the Interim requirements above) as well as FINAL limitations for FGD wastewater are established at a new IMP 009, which are applicable December 1, 2023, pending modifications to 40 CFR Part 423 by EPA.

Final Permit Limits for FGD wastewater at IMP 009, following construction/startup of new wastewater treatment and division approval of the initial operating period, monthly reporting is established for these parameters. IMP 009 is established as the point of compliance for treated FGD wastewater ELGS prior to mixing with the discharge from the FGD landfill process water pond, which is designated IMP 01A.

Description : Internal Monitoring Point, Number : 009, Monitoring : Effluent Gross, Season : All Year

Code	Parameter	Qualifier	Value	Unit	Sample Type	Frequency	Statistical Base
01002	Arsenic, total (as As)	<=	11.0	ug/L	Grab	Weekly	Daily Maximum
01002	Arsenic, total (as As)	<=	8.0	ug/L	Grab	Weekly	Monthly Average
01027	Mercury, total (as Hg)	<=	788	ng/L	Grab	Weekly	Daily Maximum
01027	Mercury, total (as Hg)	<=	356	ng/L	Grab	Weekly	Monthly Average
01092	Nitrite plus Nitrate, total (as N)	<=	17.0	mg/L	Grab	Weekly	Daily Maximum
01092	Nitrite plus Nitrate, total (as N)	<=	4.4	mg/L	Grab	Weekly	Monthly Average
01147	Selenium, total (as Se)	<=	23.0	ug/L	Grab	Weekly	Monthly Average
01147	Selenium, total (as Se)	<=	12.0	ug/L	Grab	Weekly	Daily Maximum
50050	Flow	Report	-	MGD	Continuous	Weekly	Monthly Average
50050	Flow	Report	-	MGD	Continuous	Weekly	Daily Maximum

OUTFALL 01B – EMERGENCY OVERFLOW – POND AT FGD DEWATERING/LANDFILL WASTEWATER

In circumstances resulting from a probable maximum precipitation event, TVA will collect and maintain records on the duration of the event, the amount of precipitation affecting the overflow, and results of an inspection of the pond for structural stability in accordance with Part III of the permit

IMP 005 – CHEMICAL METAL CLEANING WASTEWATER

EFFLUENT LIMITS – IMP 005
Chemical Cleaning Wastewater (non-hazardous portion)

Description: Internal Outfall, Number: IMP 005, Monitoring: Effluent Gross, Season: All Year

Code	Parameter	Qualifier	Value	Unit	Sample Type	Frequency	Statistical Base
01042	Copper	<=	1.0	mg/L	Grab	Monthly	Daily Maximum
01045	Iron	<=	1.0	mg/L	Grab	Monthly	Daily Maximum

BEST PROFESSIONAL JUDGEMENT OF EXISTING COOLING WATER INTAKE STRUCTURE

Using available information to date, TDEC has determined that the cooling water intake structure used by the Kingston Fossil Plant represents the best technology available (BTA) to minimize adverse environmental impact in accordance with Section 316(b) of the federal Clean Water Act (33 U.S.C. section 1326). Additional data required to be collected by the Compliance Schedule is described in Section N.

Additional monitoring requirements and conditions applicable to all outfalls include:

There shall be no distinctly visible floating solids, scum, foam, oily slick, or the formation of slimes, bottom deposits or sludge banks of such size or character that may be detrimental to fish and aquatic life.

The wastewater discharge shall not contain pollutants in quantities that will be hazardous or otherwise detrimental to humans, livestock, wildlife, plant life, or fish and aquatic life in the receiving stream.

In accordance with 40 CFR 423.12(b)(2) and 423.13(a), there shall be no discharge of polychlorinated biphenyl compounds such as those commonly used for transformer fluid.

Nothing in this permit authorizes take for the purposes of a facility's compliance with the Endangered Species Act. (40 C.F.R. 125.98(b)(1))

MONITORING PROCEDURES

1. Representative Sampling

Samples and measurements taken in compliance with the monitoring requirements specified herein shall be representative of the volume and nature of the monitored discharge, and shall be taken after treatment and prior to mixing with uncontaminated storm water runoff or the receiving stream.

2. Sampling Frequency

Where the permit requires sampling and monitoring of a particular effluent characteristic(s) at a frequency of less than once per day or daily, the permittee is precluded from marking the “No Discharge” block on the Discharge Monitoring Report if there has been any discharge from that particular outfall during the period which coincides with the required monitoring frequency, i.e. if the required monitoring frequency is once per month or 1/month, the monitoring period is one month, and if the discharge occurs during only one day in that period then the permittee must sample on that day and report the results of analyses accordingly.

3. Test Procedures

a. Test procedures for the analysis of pollutants shall conform to regulations published pursuant to Section 304 (h) of the Clean Water Act (the "Act"), as amended, under which such procedures may be required.

b. Unless otherwise noted in the permit, all pollutant parameters shall be determined according to methods prescribed in Title 40, CFR Part 136, as amended, promulgated pursuant to Section 304 (h) of the Act.

In instances where permit limits established through implementation of applicable water criteria are below analytical capabilities, compliance with those limits will be determined using the detection limits described in the TN Rules, Chapter 0400-40-03-.05(8).

4. Recording of Results

For each measurement or sample taken pursuant to the requirements of this permit, the permittee shall record the following information:

a. The exact place, date and time of sampling;
b. The exact person(s) collecting samples;
c. The dates and times the analyses were performed;
d. The person(s) or laboratory who performed the analyses;
e. The analytical techniques or methods used, and;
f. The results of all required analyses.

5. Records Retention

All records and information resulting from the monitoring activities required by this permit including all records of analyses performed and calibration and maintenance of instrumentation

shall be retained for a minimum of three (3) years, or longer, if requested by the Division of Water Resources.

DEFINITIONS

For the purpose of this permit, ***Annually*** is defined as a monitoring frequency of once every twelve (12) months beginning with the date of issuance of this permit so long as the following set of measurements for a given 12 month period are made approximately 12 months subsequent to that time.

A ***bypass*** is defined as the intentional diversion of waste streams from any portion of a treatment facility.

A ***calendar day*** is defined as the 24-hour period from midnight to midnight or any other 24-hour period that reasonably approximates the midnight to midnight time period.

A **Composite Sample**, for the purposes of this permit, is a sample collected continuously over a period of 24-hours at a rate proportional to the flow. Composite sample should be a combination of at least 8 sample aliquots of at least 100 milliliters, collected at periodic intervals during the operating hours of a facility over a 24-hour period.

Continuous monitoring, for the purposes of this permit, is the measurement of flow, total dissolved solids, and turbidity at a frequency that will accurately characterize the nature of discharges from the site and water in the receiving stream. Samples collected continuously shall be at a frequency of not less than once every fifteen minutes for flow, and not less than once per hour for turbidity and total dissolved solids.

Cooling water means water used for contact or non-contact cooling, including water used for equipment cooling, evaporative cooling tower makeup, and dilution of effluent heat content. The intended use of the cooling water is to absorb waste heat rejected from the process or processes used, or from auxiliary operations on the facility's premises.

Cooling water intake structure means the total physical structure and any associated constructed waterways used to withdraw cooling water from waters of the United States. The cooling water intake structure extends from the point at which water is first withdrawn from waters of the United States up to, and including the intake pumps***.***

Actual Intake Flow (AIF) means the average volume of water withdrawn on an annual basis by the cooling water intake structures over the past three years.

Design intake flow (DIF) means the value assigned during the cooling water intake structure design to the maximum instantaneous rate of flow of water the cooling water intake system is capable of withdrawing from a source waterbody.

Entrainment- means the incorporation of all life stages of fish and shellfish with intake water flow entering and passing through a cooling water intake structure and into a cooling water system.

Impingement- means the entrapment of all life stages of fish and shellfish on the outer part of an intake structure or against a screening device during periods of intake water withdrawal.

The ***Daily Maximum Amount***, is a limitation measured in pounds per day (lb/day), on the total amount of any pollutant in the discharge by weight during any calendar day.

The ***Daily Maximum Concentration*** is a limitation on the average concentration, in milligrams per liter (mg/L), of the discharge during any calendar day. When a proportional-to-flow composite sampling device is used, the daily concentration is the concentration of that 24-hour composite; when other sampling means are used, the daily concentration is the arithmetic mean of the concentrations of equal volume samples collected during any calendar day or sampling period.

"Degradation" means the alteration of the properties of waters by the addition of pollutants, withdrawal of water, or removal of habitat, except those alterations of a short duration.

"***De Minimis***" - Degradation of a small magnitude, as provided in this paragraph.

(a) Discharges and withdrawals

1. Subject to the limitation in part 3 of this subparagraph, a single discharge other than those from new domestic wastewater sources will be considered de minimis if it uses less than five percent of the available assimilative capacity for the substance being discharged.

2. Subject to the limitation in part 3 of this subparagraph, a single water withdrawal will be considered de minimis if it removes less than five percent of the 7Q10 flow of the stream.

3. If more than one activity described in part 1 or 2 of this subparagraph has been authorized in a segment and the total of the authorized and proposed impacts uses no more than 10% of the assimilative capacity, or 7Q10 low flow, they are presumed to be de minimis. Where the total of the authorized and proposed impacts uses 10% of the assimilative capacity, or 7Q10 low flow, additional degradation may only be treated as de minimis if the Division finds on a scientific basis that the additional degradation has an insignificant effect on the resource.

(b) Habitat alterations authorized by an Aquatic Resource Alteration Permit (ARAP) are de minimis if the Division finds that the impacts, individually and cumulatively are offset by impact minimization and/or in-system mitigation, provided however, in ONRWs the mitigation must occur within the ONRW.

Discharge or "discharge of a pollutant" refers to the addition of pollutants to waters from a source.

Dry Weather Flow shall be construed to represent discharges consisting of process and/or non-process wastewater only.

An ***ecoregion*** is a relatively homogeneous area defined by similarity of climate, landform, soil, potential natural vegetation, hydrology, or other ecologically relevant variables.

The ***geometric mean*** of any set of values is the n^{th} root of the product of the individual values where "n" is equal to the number of individual values. The geometric mean is equivalent

to the antilog of the arithmetic mean of the logarithms of the individual values. For the purposes of calculating the geometric mean, values of zero (0) shall be considered to be one (1).

A ***Grab Sample***, for the purposes of this permit, is defined as a single effluent sample of at least 100 milliliters (sample volumes <100 milliliters are allowed when specified per standard methods, latest edition) collected at a randomly selected time over a period not exceeding 15 minutes. The sample(s) shall be collected at the period(s) most representative of the total discharge.

The ***Instantaneous Concentration*** is a limitation on the concentration, in milligrams per liter (mg/L), of any pollutant contained in the discharge determined from a grab sample taken at any point in time.

The ***monthly average amount***, shall be determined by the summation of all the measured daily discharges by weight divided by the number of days during the calendar month when the measurements were made.

The ***monthly average concentration***, other than for *E. coli* bacteria, is the arithmetic mean of all the composite or grab samples collected in a one-calendar month period.

A ***one week period*** (or ***calendar-week***) is defined as the period from Sunday through Saturday. For reporting purposes, a calendar week that contains a change of month shall be considered part of the latter month.

Pollutant means sewage, industrial wastes, or other wastes.

A **Qualifying Storm Event** is one which is greater than 0.1 inches and that occurs after a period of at least 72 hours after any previous storm event with rainfall of 0.1 inches or greater.

For the purpose of this permit, a ***Quarter*** is defined as any one of the following three month periods: January 1 through March 31, April 1 through June 30, July 1 through September 30, or October 1 through December 31.

A ***rainfall event*** is defined as any occurrence of rain, preceded by 10 hours without precipitation that results in an accumulation of 0.01 inches or more. Instances of rainfall occurring within 10 hours of each other will be considered a single rainfall event.

A ***rationale*** (or “fact sheet”) is a document that is prepared when drafting an NPDES permit or permit action. It provides the technical, regulatory and administrative basis for an agency’s permit decision.

A ***reference site*** means least impacted waters within an ecoregion that have been monitored to establish a baseline to which alterations of other waters can be compared.

A ***reference condition*** is a parameter-specific set of data from regional reference sites that establish the statistical range of values for that particular substance at least-impacted streams.

For the purpose of this permit, ***Semi-annually*** means the same as "once every six months." Measurements of the effluent characteristics concentrations may be made anytime

during a 6 month period beginning from the issuance date of this permit so long as the second set of measurements for a given 12 month period are made approximately 6 months subsequent to that time, if feasible.

A ***subecoregion*** is a smaller, more homogenous area that has been delineated within an ecoregion.

Upset means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

The term, ***washout*** is applicable to activated sludge plants and is defined as loss of mixed liquor suspended solids (MLSS) of 30.00% or more from the aeration basin(s).

Waters means any and all water, public or private, on or beneath the surface of the ground, which are contained within, flow through, or border upon Tennessee or any portion thereof except those bodies of water confined to and retained within the limits of private property in single ownership which do not combine or effect a junction with natural surface or underground waters.

The ***weekly average amount***, shall be determined by the summation of all the measured daily discharges by weight divided by the number of days during the calendar week when the measurements were made.

The ***weekly average concentration***, is the arithmetic mean of all the composite samples collected in a one-week period. The permittee must report the highest weekly average in the one-month period.

Wet Weather Flow shall be construed to represent storm water runoff which, in combination with all process and/or non-process wastewater discharges, as applicable, is discharged during a qualifying storm event.

ACRONYMS AND ABBREVIATIONS

1Q10 – 1-day minimum, 10-year recurrence interval
30Q5 – 30-day minimum, 5-year recurrence interval
7Q10 – 7-day minimum, 10-year recurrence interval
BAT – best available technology economically achievable
BCT – best conventional pollutant control technology
BDL – below detection level
BOD_5 – five day biochemical oxygen demand
BPT – best practicable control technology currently available
$CBOD_5$ – five day carbonaceous biochemical oxygen demand
CEI – compliance evaluation inspection
CFR – code of federal regulations
CFS – cubic feet per second
CFU – colony forming units

CIU – categorical industrial user
CSO – combined sewer overflow
DMR – discharge monitoring report
D.O. – dissolved oxygen
E. coli – Escherichia coli
EFO – environmental field office
LB(lb) - pound
IC_{25} – inhibition concentration causing 25% reduction in survival, reproduction and growth of the test organisms
IU – industrial user
IWS – industrial waste survey
LC_{50} – acute test causing 50% lethality
MDL – method detection level
MGD – million gallons per day
MG/L(mg/l) – milligrams per liter
ML – minimum level of quantification
ml – milliliter
MLSS – mixed liquor suspended solids
MOR – monthly operating report
NODI – no discharge
NOEC – no observed effect concentration
NPDES – national pollutant discharge elimination system
PL – permit limit
POTW – publicly owned treatment works
RDL – required detection limit
SAR – semi-annual [pretreatment program] report
SIU – significant industrial user
SSO – sanitary sewer overflow
STP – sewage treatment plant
TCA – Tennessee code annotated
TDEC – Tennessee Department of Environment and Conservation
TIE/TRE – toxicity identification evaluation/toxicity reduction evaluation
TMDL – total maximum daily load
TRC – total residual chlorine
TSS – total suspended solids
WQBEL – water quality based effluent limit

REPORTING

1. Monitoring Results

Monitoring results shall be continue to be recorded monthly and submitted monthly using NETDMR. Submittals shall be no later than 15 days after the completion of the reporting period. If NETDMR is not functioning, a completed DMR with an original signature shall be submitted to the following address:

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DIVISION OF WATER RESOURCES
COMPLIANCE & ENFORCEMENT SECTION
William R. Snodgrass - Tennessee Tower
312 Rosa L. Parks Avenue, 11th Floor
Nashville, Tennessee 37243-1102

If NETDMR is not functioning, a copy of the completed and signed DMR shall be mailed to Knoxville Environmental Field Office (EFO) at the following address:

TENNESSEE DEPT. OF ENVIRONMENT & CONSERVATION
Knoxville Environmental Field Office -
Division of Water Resources
3711 Middlebrook Pike,
Knoxville, TN 37921

The first DMR is due on the 15th of the month following permit effectiveness.

2. Additional Monitoring by Permittee

If the permittee monitors any pollutant specifically limited by this permit more frequently than required at the location(s) designated, using approved analytical methods as specified herein, the results of such monitoring shall be included in the calculation and reporting of the values required in the DMR form. Such increased frequency shall also be indicated on the form.

3. Falsifying Results and/or Reports

Knowingly making any false statement on any report required by this permit or falsifying any result may result in the imposition of criminal penalties as provided for in Section 309 of the Federal Water Pollution Control Act, as amended, and in Section 69-3-115 of the Tennessee Water Quality Control Act.

4. Outlier Data

Outlier data include analytical results that are probably false. The validity of results is based on operational knowledge and a properly implemented quality assurance program. False results may include laboratory artifacts, potential sample tampering, broken or suspect sample containers, sample contamination or similar demonstrated quality control flaw.

Outlier data are identified through a properly implemented quality assurance program, and according to ASTM standards (e.g. Grubbs Test, ‘h’ and ‘k’ statistics). Furthermore, outliers should be verified, corrected, or removed, based on further inquiries into the matter. If an outlier was verified (through repeated testing and/or analysis), it should remain in the preliminary data set. If an outlier resulted from a transcription or similar clerical error, it should be corrected and subsequently reported.

Therefore, only if an outlier was associated with problems in the collection or analysis of the samples and as such does not conform with the Guidelines Establishing Test Procedures for

the Analysis of Pollutants (40 CFR §136), it can be removed from the data set and not reported on the Discharge Monitoring Report forms (DMRs). Otherwise, all results (including monitoring of pollutants more frequently than required at the location(s) designated, using approved analytical methods as specified in the permit) should be included in the calculation and reporting of the values required in the DMR form. You are encouraged to use "comment" section of the DMR form (or attach additional pages), in order to explain any potential outliers or dubious results.

SCHEDULE OF COMPLIANCE

Except for those provisions listed in this section, full compliance shall be attained from the effective date of this permit.

Cooling Water Intake Structure Requirements

A schedule of compliance is granted for the 5-year period of the permit term to complete compliance requirements under Section 316(b) of CWA. Due to the number and complexity of studies, reports, and peer reviews to be conducted and the time needed to complete such efforts, this renewed permit establishes an alternate schedule for submittal of information specified in § 122.21 (r)(2) through § 122.21 (r)(13) no later than 180 days prior to the expiration date.

Seep Action Plan

TVA shall submit a Seep Action Plan within 90 days from the permit effective date in accordance with Part III of the Permit.

Technology-Based Limits and Steam Electric ELGs

Additional time is granted to achieve compliance with the TNWQCA, CWA, and applicable regulations. This schedule requires compliance by the permittee *as soon as possible*, but does not extend the date for final compliance beyond the dates established by the CWA.

Requirement	Applicability Date
Bottom Ash No-Discharge	by December 1, 2023
FGD Wastewater IMP 009 Final Permit Limits	by December 1, 2023
Annual Report*	Annually by January 31 each calendar year

*In order to keep TDEC abreast of TVA's progress toward installing the necessary equipment to meet the wet FGD wastewater and bottom ash transport water limits, this permit requires TVA to provide TDEC with an annual report detailing progress achieved during the preceding calendar year. This report will be submitted by January 31 of each calendar year detailing the projects progress from the preceding year and identifying upcoming projects needed to attain compliance.

It is recognized that the above compliance schedule is site-specific to allow completion of compliance actions beyond the term of this permit. TVA has provided sufficient information with the permit renewal application (included in the Rationale) to demonstrate that this schedule reflects the appropriate applicability dates and considers the factors identified in 40 CFR 423.11(t). TDEC has approved this schedule as meeting the "as soon as possible" requirement.

PART II – GENERAL PROVISIONS

A. GENERAL PROVISIONS

1. Duty to Reapply

Permittee is not authorized to discharge after the expiration date of this permit. In order to receive authorization to discharge beyond the expiration date, the permittee shall submit such information and forms as are required to the Director of Water Resources (the "Director") no later than 180 days prior to the expiration date. Such applications must be properly signed and certified.

2. Right of Entry

The permittee shall allow the Director, the Regional Administrator of the U.S. Environmental Protection Agency, or their authorized representatives, upon the presentation of credentials:

a. To enter upon the permittee's premises where an effluent source is located or where records are required to be kept under the terms and conditions of this permit, and at reasonable times to copy these records;

b. To inspect at reasonable times any monitoring equipment or method or any collection, treatment, pollution management, or discharge facilities required under this permit; and

c. To sample at reasonable times any discharge of pollutants.

3. Availability of Reports

Except for data determined to be confidential under Section 308 of the Federal Water Pollution Control Act, as amended, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the Division of Water Resources. As required by the Federal Act, effluent data shall not be considered confidential.

4. Proper Operation and Maintenance

a. The permittee shall at all times properly operate and maintain all facilities and systems (and related appurtenances) for collection and treatment which are installed or used by the permittee to achieve compliance with the terms and conditions of this permit. Proper operation and maintenance also includes adequate laboratory and process controls and appropriate quality assurance procedures. This provision requires the operation of backup or auxiliary facilities or similar systems which are installed by a permittee only when the operation is necessary to achieve compliance with the conditions of the permit. Backup continuous pH and flow monitoring equipment are not required.

b. Dilution water shall not be added to comply with effluent requirements to achieve BCT, BPT, BAT and or other technology-based effluent limitations such as those in State of Tennessee Rule 1200-4-5-.09.

5. Treatment Facility Failure

The permittee, in order to maintain compliance with this permit, shall control production, all discharges, or both, upon reduction, loss, or failure of the treatment facility, until the facility is restored or an alternative method of treatment is provided. This requirement applies in such situations as the reduction, loss, or failure of the primary source of power.

6. Property Rights

The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of Federal, State, or local laws or regulations.

7. Severability

The provisions of this permit are severable. If any provision of this permit due to any circumstance, is held invalid, then the application of such provision to other circumstances and to the remainder of this permit shall not be affected thereby.

8. Other Information

If the permittee becomes aware that he failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to the Director, then he shall promptly submit such facts or information.

B. CHANGES AFFECTING THE PERMIT

1. Planned Changes

The permittee shall give notice to the Director as soon as possible of any planned physical alterations or additions to the permitted facility. Notice is required only when:

a. The alteration or addition to a permitted facility may meet one of the criteria for determining whether a facility is a new source in 40 CFR 122.29(b); or

b. The alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification applies to pollutants which are subject neither to effluent limitations in the permit, nor to notification requirements under 40 CFR 122.42(a)(1).

2. Permit Modification, Revocation, or Termination

a. This permit may be modified, revoked and reissued, or terminated for cause as described in 40 CFR 122.62 and 122.64, Federal Register, Volume 49, No. 188 (Wednesday, September 26, 1984), as amended.

b. The permittee shall furnish to the Director, within a reasonable time, any information which the Director may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit, or to determine compliance with this permit. The permittee shall also furnish to the Director, upon request, copies of records required to be kept by this permit.

c. If any applicable effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is established for any toxic pollutant under Section 307(a) of the Federal Water Pollution Control Act, as amended, the Director shall modify or revoke and reissue the permit to conform to the prohibition or to the effluent standard, providing that the effluent standard is more stringent than the limitation in the permit on the toxic pollutant. The permittee shall comply with these effluent standards or prohibitions within the time provided in the regulations that establish these standards or prohibitions, even if the permit has not yet been modified or revoked and reissued to incorporate the requirement.

d. The filing of a request by the permittee for a modification, revocation, reissuance, termination, or notification of planned changes or anticipated noncompliance does not halt any permit condition.

3. Change of Ownership

This permit may be transferred to another party (provided there are neither modifications to the facility or its operations, nor any other changes which might affect the permit limits and conditions contained in the permit) by the permittee if:

a. The permittee notifies the Director of the proposed transfer at least 30 days in advance of the proposed transfer date;

b. The notice includes a written agreement between the existing and new permittees containing a specified date for transfer of permit responsibility, coverage, and liability between them; and

c. The Director, within 30 days, does not notify the current permittee and the new permittee of his intent to modify, revoke or reissue, or terminate the permit and to require that a new application be filed rather than agreeing to the transfer of the permit.

Pursuant to the requirements of 40 CFR 122.61, concerning transfer of ownership, the permittee must provide the following information to the division in their formal notice of intent to transfer ownership: 1) the NPDES permit number of the subject permit; 2) the effective date of the proposed transfer; 3) the name and address of the transferor; 4) the name and address of the transferee; 5) the names of the responsible parties for both the transferor and transferee; 6) a statement that the transferee assumes responsibility for the subject NPDES permit; 7) a statement that the transferor relinquishes responsibility for the subject NPDES permit; 8) the signatures of the responsible parties for both the transferor and transferee pursuant to the requirements of 40 CFR 122.22(a), “Signatories to permit applications”; and, 9) a statement regarding any proposed modifications to the facility, its operations, or any other changes which might affect the permit limits and conditions contained in the permit.

4. Change of Mailing Address

The permittee shall promptly provide to the Director written notice of any change of mailing address. In the absence of such notice the original address of the permittee will be assumed to be correct.

C. NONCOMPLIANCE

1. Effect of Noncompliance

All discharges shall be consistent with the terms and conditions of this permit. Any permit noncompliance constitutes a violation of applicable State and Federal laws and is grounds for enforcement action, permit termination, permit modification, or denial of permit reissuance.

2. Reporting of Noncompliance

a. 24-Hour Reporting

In the case of any noncompliance which could cause a threat to public drinking supplies, or any other discharge which could constitute a threat to human health or the environment, the required notice of non-compliance shall be provided to the Division of Water Resources in the appropriate Environmental Assistance Center within 24-hours from the time the permittee becomes aware of the circumstances. (The Environmental Assistance Center should be contacted for names and phone numbers of environmental response personnel).

A written submission must be provided within five days of the time the permittee becomes aware of the circumstances unless this requirement is waived by the Director on a case-by-case basis. The permittee shall provide the Director with the following information:

i. A description of the discharge and cause of noncompliance;
ii. The period of noncompliance, including exact dates and times or, if not corrected, the anticipated time the noncompliance is expected to continue; and
iii. The steps being taken to reduce, eliminate, and prevent recurrence of the noncomplying discharge.

b. Scheduled Reporting

For instances of noncompliance which are not reported under subparagraph 2.a. above, the permittee shall report the noncompliance on the Discharge Monitoring Report. The report shall contain all information concerning the steps taken, or planned, to reduce, eliminate, and prevent recurrence of the violation and the anticipated time the violation is expected to continue.

3. Sanitary Sewer Overflow

a. "Sanitary Sewer Overflow" means the discharge to land or water of domestic wastewater from any portion of the sanitary sewer collection, transmission, or treatment system other than through permitted outfalls.

b. Sanitary Sewer Overflows are prohibited.

c. The permittee shall operate the sanitary sewer collection system so as to avoid sanitary sewer overflows.

4. Upset

a. "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

b. An upset shall constitute an affirmative defense to an action brought for noncompliance with such technology-based permit effluent limitations if the permittee demonstrates, through properly signed, contemporaneous operating logs, or other relevant evidence that:

i. An upset occurred and that the permittee can identify the cause(s) of the upset;

ii. The permitted facility was at the time being operated in a prudent and workman-like manner and in compliance with proper operation and maintenance procedures;

iii. The permittee submitted information required under "Reporting of Noncompliance" within 24-hours of becoming aware of the upset (if this information is provided orally, a written submission must be provided within five days); and

iv. The permittee complied with any remedial measures required under "Adverse Impact."

5. Adverse Impact

The permittee shall take all reasonable steps to minimize any adverse impact to the waters of Tennessee resulting from noncompliance with this permit, including such accelerated or additional monitoring as necessary to determine the nature and impact of the noncomplying discharge. It shall not be a defense for the permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

6. Bypass

a. "Bypass" is the intentional diversion of wastewater away from any portion of a treatment facility. "Severe property damage" means substantial physical damage to property, damage to the treatment facilities which would cause them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

b. Bypasses are prohibited unless the following 3 conditions are met:

i. The bypass is unavoidable to prevent loss of life, personal injury, or severe property damage;

ii. There are not feasible alternatives to bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occurred during normal periods of equipment down-time or preventative maintenance;

iii. The permittee submits notice of an unanticipated bypass to the Division of Water Resources in the appropriate environmental field office within 24-hours of becoming aware of the bypass (if this information is provided orally, a written submission must be provided within five days). When the need for the bypass is foreseeable, prior notification shall be submitted to the Director, if possible, at least 10 days before the date of the bypass.

Bypasses not exceeding limitations are allowed only if the bypass is necessary for essential maintenance to assure efficient operation. All other bypasses are prohibited. Allowable bypasses not exceeding limitations are not subject to the reporting requirements of 6.b.iii, above.
Bypass does not include diverting from one treatment unit of treatment facility to another for alternate treatment.

7. Washout

a. For domestic wastewater plants only, a "washout" shall be defined as loss of Mixed Liquor Suspended Solids (MLSS) of 30.00% or more. This refers to the MLSS in the aeration basin(s) only. This does not include MLSS decrease due to solids wasting to the sludge disposal system. A washout can be caused by improper operation or from peak flows due to infiltration and inflow.

b. A washout is prohibited. If a washout occurs the permittee must report the incident to the Division of Water Resources in the appropriate Environmental Field Office within 24-hours by telephone. A written submission must be provided within 5 days. The washout must be noted on the discharge monitoring report. Each day of a washout is a separate violation.

D. LIABILITIES

1. Civil and Criminal Liability

Except as provided in permit conditions for "Bypassing," “Overflow,” and "Upset," nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance. Notwithstanding this permit, the permittee shall remain liable for any damages sustained by the State of Tennessee, including but not limited to fish kills and losses of aquatic life and/or wildlife, as a result of the discharge of wastewater to any surface or subsurface waters. Additionally, notwithstanding this Permit, it shall be the responsibility of the permittee to conduct its wastewater treatment and/or discharge activities in a manner such that public or private nuisances or health hazards will not be created.

2. Liability Under State Law

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable State law or the Federal Water Pollution Control Act, as amended.

PART III - OTHER REQUIREMENTS

A. TOXIC POLLUTANTS

The permittee shall notify the Division of Water Resources as soon as it knows or has reason to believe:

1. That any activity has occurred or will occur which would result in the discharge on a routine or frequent basis, of any toxic substance(s) (listed at 40 CFR 122, Appendix D, Table II and III) which is not limited in the permit, if that discharge will exceed the highest of the following "notification levels":

    a. One hundred micrograms per liter (100 ug/l);

    b. Two hundred micrograms per liter (200 ug/l) for acrolein and acrylonitrile; five hundred micrograms per liter (500 ug/l) for 2,4-dinitrophenol and for 2-methyl-4,6-dinitrophenol; and one milligram per liter (1 mg/L) for antimony;

    c. Five (5) times the maximum concentration value reported for that pollutant(s) in the permit application in accordance with 122.21(g)(7); or

    d. The level established by the Director in accordance with 122.44(f).

2. That any activity has occurred or will occur which would result in any discharge, on a non-routine or infrequent basis, of a toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the following "notification levels":

    a. Five hundred micrograms per liter (500 ug/l);

    b. One milligram per liter (1 mg/L) for antimony;

    c. Ten (10) times the maximum concentration value reported for that pollutant in the permit application in accordance with 122.21(g)(7); or

    d. The level established by the Director in accordance with 122.44(f).

B. REOPENER CLAUSE

If an applicable standard or limitation is promulgated under CWA Sections 301(b)(2)(C) and (D), 304(B)(2), and 307(a)(2) and that effluent standard or limitation is more stringent than any effluent limitation in the permit or controls a pollutant not limited in the permit, the permit shall be promptly modified or revoked and reissued to conform to that effluent standard or limitation.

As defined by EPA rules and Part I of the Permit, should any future rulemaking establish revised ELGs, the permit would be reopened.

C. PLACEMENT OF SIGNS

Within sixty (60) days of the effective date of this permit, the permittee shall place and maintain a sign(s) at each outfall and any bypass/overflow point in the collection system. For the purposes of this requirement, any bypass/overflow point that has discharged five (5) or more times in the last year must be so posted. The sign(s) should be clearly visible to the public from the bank and the receiving stream or from the nearest public property/right-of-way, if applicable. The minimum sign size should be two feet by two feet (2' x 2') with one inch (1") letters. The sign should be made of durable material and have a white background with black letters.

The sign(s) are to provide notice to the public as to the nature of the discharge and, in the case of the permitted outfalls, that the discharge is regulated by the Tennessee Department of Environment and Conservation, Division of Water Resources. The following is given as an example of the minimal amount of information that must be included on the sign:

TREATED INDUSTRIAL WASTEWATER
«Permittee_Name»
(Permittee's Phone Number)
NPDES Permit NO. «PERMIT_NUMBER»
TENNESSEE DIVISION OF WATER RESOURCES
1-888-891-8332 ENVIRONMENTAL FIELD OFFICE - «EFO_Name»

D. SEEPS

i. Seep Action Plan

TVA shall submit a Seep Action Plan describing inspection of the plant property containing inactive ash disposal areas and response to any findings of seeps. The Plan will be submitted for Division approval within 90 days of the permit effective date.

ii. Contents of Seep Action Plan

The Seep Action Plan should address the following, as a minimum:

- Inspection requirements of former ash disposal areas to identify seeps;
- Measures for expedited repairs of seeps upon discovery;
- Submission of an annual report of results of seep inspections, a listing of seep conditions, and remedial actions completed and in progress;
- Submission of the annual report by July 1 of each year.
- A protocol for assessing existing and/or newly identified seeps as to the potential for discharge to surface waters, methods used in assessing potential effects on surface waters, and duration and frequency (at least a quarterly) of the assessment methods.
- Design, and engineering and various construction approaches planned for use in repairing a range of seeps, to include collection and routing the seep flow to an existing treatment system/permitted outfall.
- A procedure whereby TVA will notify TDEC of proposed discharge worthy of requesting a modification to the NPDES permit for an additional permitted outfall.
- To ensure structural stability is maintained at repaired seeps, continued dike inspection procedures which are equivalent to requirements in in the Dike Inspections section below.

E. DIKE INSPECTIONS AT REPAIRED SEEPS FOR FORMER ASH DISPOSAL AREAS

1. Implement dike inspection requirements in accordance with the approved Seep Action Plan.
2. The permittee must repair seeps in a manner that protects the structural integrity of the former disposal area, and either:

    a. Eliminate any discharge to surface waters from the seep, or,
    b. Reroute any flow back to an approved treatment unit for discharge to surface waters through a permitted outfall, or
    c. Repair the seep in a manner that protects the structural integrity of the former disposal area while allowing flow from the seep to continue. In this case, the permittee must:
        1. Notify the Department and receive approval for this repair; and,
        2. Repair the seep and collect all flow through the seep and return the wastewater to the wastewater treatment unit, or
        3. Demonstrate to the Department that the continued flow through the seep after the repair meets published TN water quality criteria, (and continues to meet WQC from assessments conducted at least quarterly) or,
        4. Request a modification to the NPDES permit for an additional permitted outfall comprised of the continued flow from the seep.

F. REMOVED SUBSTANCES

If sludge or any other material removed by any treatment works is subsequently removed from such treatment works for permanent disposal elsewhere, such disposal must be in compliance with the Tennessee Solid Waste Disposal Act, TCA 68-31-101 et seq. and the Tennessee Hazardous Waste Management Act, TCA 68-46-101 et seq., and must prevent its entrance into or pollution of any surface or subsurface waters.

G. BIOMONITORING REQUIREMENTS, CHRONIC – OUTFALL 002

The toxicity tests at Outfall 002 specified herein shall be conducted annually during a period of biocide application. Reports will be attached to the monthly DMR.

The permittee shall conduct a 3-Brood *Ceriodaphnia dubia* Survival and Reproduction Test and a 7-Day Fathead Minnow *(Pimephales promelas)* Larval Survival and Growth Test on the same samples of final effluent from Outfall 002.

The measured endpoint for toxicity will be the inhibition concentration causing 25% reduction (IC25) in survival, reproduction, or growth of the test organisms. The IC25 shall be determined based on a 25% reduction as compared to the controls. The average reproduction and growth responses will be determined based on the number of *Ceriodaphnia dubia* or *Pimephales promelas* larvae used to initiate the test.

Test shall be conducted and its results reported based on appropriate replicates of a total of five serial dilutions and a control, using the percent effluent dilutions as presented in the following table:

Serial Dilutions for Whole Effluent Toxicity (WET) Testing					
Permit Limit (PL)	**0.50 X PL**	**0.25 X PL**	**0.125 X PL**	**0.0625 X PL**	**Control**
% effluent					
100	**50**	**25**	**12.5**	**6.25**	**0**

The dilution/control water used will be a moderately hard water as described in Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, EPA-821-R-02-013 (or the most current edition). Results from a chronic standard reference toxicant quality assurance test for each species tested shall be submitted with the discharge monitoring report. Reference toxicant tests shall be conducted as required in EPA-821-R-02-013 (or the most current edition). Additionally, the analysis of this multi-concentration test shall include review of the concentration-response relationship to ensure that calculated test results are interpreted appropriately.

Toxicity will be demonstrated if the IC25 is less than or equal to the permit limit indicated for each outfall in the above table(s). However, if intake samples (tested concurrently with the effluent) are shown to be toxic enough to represent a test failure (100 percent effluent samples are statistically less than controls using t-tests and minnow growth or C. dubia reproduction is 25 percent less than controls) and if effluent toxicity is not statistically greater than calculated intake toxicity, the effluent toxicity test in question will be considered invalid. In the event these two above described conditions occur, the toxicity test shall be repeated according to the schedule requirements for test failure. Effluent toxicity which is not consistent with the intake toxicity conditions specified above constitutes a violation of this permit. The permittee is allowed to treat samples collected for toxicity testing on Pimephales promelas with UV radiation only in accordance with subsequent written approval from the division.

When effluent toxicity is demonstrated and ambient samples run concurrently with effluent tests are also shown to be toxic enough to represent a test failure (100 percent samples statistically less than controls using t-tests and minnow growth or daphnid reproduction is 25 less than controls), the test will be repeated and the failed effluent test will not be considered a permit violation. Effluent toxicity demonstrated by the tests specified here in which is not shown to be related to ambient conditions constitutes a violation of this permit.

All tests will be conducted using a minimum of three 24-hour flow-proportionate composite samples of final effluent (e.g., collected on days 1, 3 and 5). If, in any control more than 20% of the test organisms die in 7 days, the test (control and effluent) is considered invalid and the test shall be repeated within 30 days of the date the initial test is invalidated. Furthermore, if the results do not meet the acceptability criteria of section 4.9.1, EPA-821-R-02-013 (or the most current edition), or if the required concentration-response review fails to yield a valid relationship per guidance contained in Method Guidance and Recommendations for Whole Effluent Toxicity (WET) Testing, EPA-821-B-00-004 (or the most current edition), that test shall be repeated. Any test initiated but terminated before completion must also be reported along with a complete explanation for the termination.

Furthermore, if the results do not meet the acceptability criteria as defined in *Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, EPA-821-R-02-012,* or if the required concentration-response review fails to yield a valid relationship per guidance contained in *Method Guidance and Recommendations for Whole Effluent Toxicity (WET) Testing, EPA-821-B-00-004 (*or the most current edition), that test shall be repeated. Any test initiated but terminated before completion must also be reported along with a complete explanation for the termination.

In the event of a test failure, the permittee must start a follow-up test within 2 weeks and submit results from a follow-up test within 30 days from obtaining initial WET testing results. The follow-up test must be conducted using the same serial dilutions as presented in the corresponding table(s) above. **The follow-up test will not negate an initial failed test. In addition, the failure of a follow-up test will constitute a separate permit violation which must also be reported.**

In the event of 2 consecutive test failures or 3 test failures within a 12 month period for the same outfall, the permittee must initiate a Toxicity Identification Evaluation/Toxicity Reduction Evaluation (TIE/TRE) study within 30 days and so notify the division by letter. This notification shall include a schedule of activities for the initial investigation of that outfall. **During the term of the TIE/TRE study, the frequency of biomonitoring shall be once every three months.** Additionally, the permittee shall submit progress reports once every three months throughout the term of the TIE/TRE study. The toxicity must be reduced to allowable limits for that outfall within 2 years of initiation of the TIE/TRE study. Subsequent to the results obtained from the TIE/TRE studies, the permittee may request an extension of the TIE/TRE study period if necessary to conduct further analyses. The final determination of any extension period will be made at the discretion of the division.

The TIE/TRE study may be terminated at any time upon the completion and submission of 2 consecutive tests (for the same outfall) demonstrating compliance. Following the completion of TIE/TRE study, the frequency of monitoring will return to a regular schedule, as defined previously in this section as well in Part I of the permit. **During the course of the TIE/TRE study, the permittee will continue to conduct toxicity testing of the outfall being investigated at the frequency of once every three months but will not be required to perform follow-up tests for that outfall during the period of TIE/TRE study.**

Test procedures, quality assurance practices, determinations of effluent survival/reproduction and survival/growth values, and report formats will be made in accordance with Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, EPA-821-R-02-013, or the most current edition.

Results of all tests, reference toxicant information, copies of raw data sheets, statistical analysis and chemical analyses shall be compiled in a report. The report will be written in accordance with Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, EPA-821-R-02-013, or the most current edition.

Two copies of biomonitoring reports (including follow-up reports) shall be submitted to the division. One copy of the report shall be submitted along with the discharge monitoring report (DMR). The second copy shall be submitted to the Knoxville Division of Water Pollution Control office address.

H. BIOCIDE/CORROSION TREATMENT PLAN (B/CTP)

The use of toxic chemicals, biocides, and slimicides at the site for process and non-process flows shall be managed under a Biocide/Corrosion Treatment Plan (B/CTP). The B/CTP shall describe chemical applications and macroinvertebrate controls; include all material feed rates, and proposed monitoring schedule(s) to verify that effluent limitations are being met and water quality is being protected. The permittee shall conduct treatments of intake or process waters under this permit using biocides, dispersants, surfactants, corrosion inhibiting chemicals, or detoxification chemicals in accordance with conditions approved and specified in the permit.

The permittee shall maintain the B/CTP at the facility and make the plan available to the permit issuing authority upon request. The permittee shall amend the B/CTP whenever there is a change in the application of the chemical additives or change in the operation of the facility that materially increases the potential for these activities to result in a discharge of significant amounts of pollutants. The division shall also be notified in writing within 30-days of any material changes that will change the active ingredients or quantities used of any such chemical additives.

I. RE-ROUTING FLOWS FOR MAINTENANCE PURPOSES

The permittee shall be allowed to re-route flows past normal monitoring points as a temporary measure for maintenance activities. However, such re-routing must be done in such a way that permit limitations are still being met in the receiving waters and compliance with permit limitations is monitored and reported on the DMR's for the re-routed flows. The receiving waters must be the same for the re-routed flows as for the normal discharges.

J. FACILITY INTAKE WATER QUALITY MONITORING REQUIREMENTS

The permittee shall monitor the facility intake water for the following effluent characteristics (in mg/l): Hardness (as $CaCO_3$), TSS, Aluminum, Antimony, Arsenic, Cadmium, Chromium, Copper, Iron, Lead, Manganese, Mercury, Nickel, Selenium, Silver, Zinc, and Cyanide. All metals shall be reported as Total Recoverable Metal. **All samples reported as "Below Detection Level" shall be analyzed to the Required Detection Level (RDL) specified in Tennessee General Water Quality Criteria, Chapter 0400-40-3-.05(8) except for Mercury which shall be analyzed by EPA Method 1631 or 245.7.** Samples shall be taken annually with at least 120 days between samples. Two copies of the monitoring results shall be submitted with the Discharge Monitoring Report in the month following sample collection.

K. COMPLIANCE WITH CWA SECTION 316(A) – THERMAL DISCHARGES

TDEC will extend the thermal variance of 36.1 degrees C in the renewed permit.
Studies as outlined below shall be conducted by the permittee to confirm the performance of the KIF monitoring system and to verify that Section 316(a) of the Clean Water Act is being adequately met. The data from the studies shall be compiled with past data and reported to the Division of Water Resources with a request for continuation of the thermal variance in the next permit application.

a. The permittee shall analyze previous and new data to determine whether significant changes have occurred in plant operation, reservoir operation or instream biology that would necessitate the need for changes in the thermal variance.
b. TVA's Reservoir Fish Assemblage Index will be used to assess the overall health of the fish community in Watts Bar Reservoir. RFAI assessment includes reservoir benthic macroinvertebrate community monitoring, in addition to the fish community. Should the fish community, or particular populations fall significantly below expectations, further investigations will be proposed, and upon approval by the Division of Water Resources and EPA Region 4, initiated to verify apparent declines and assist in the identification of possible sources of impairment.

L. ANTIDEGRADATION

Pursuant to the Rules of the Tennessee Department of Environment and Conservation, Chapter 0400-40-03-.06, titled "Tennessee Antidegradation Statement," which prohibits the degradation of exceptional Tennessee waters and the increased discharges of substances that cause or contribute to impairment, the permittee shall further be required, pursuant to the terms and conditions of this permit, to comply with the effluent limitations and schedules of compliance required to implement applicable water quality standards, to comply with a State Water Quality Plan or other state or federal laws or regulations, or where practicable, to comply with a standard permitting no discharge of pollutants.

RATIONALE – OCTOBER 2017

Tennessee Valley Authority
NPDES PERMIT NO. TN0005452
Harriman, Roane County, TN

Permit Writer: Bob Alexander[1]

I. DISCHARGER

TVA Kingston Fossil Plant
714 Swan Pond Rd.
Harriman, TN 37746

Official Contact Person:
Mr. Terry E. Cheek
Senior Manager
TVA Water Compliance, Permits, and Monitoring
423-751-2201
Nature of Business:
fossil-fueled steam-electric generating plant with 9 coal-fired units with a combined rated capacity of 1,700 megawatts

SIC Code(s): 4911 (Electric, Gas, and Sanitary Services, Electric Services subcategory)
Industrial Classification: Primary
Discharger Rating: Major

II. PERMIT STATUS

TN0080870 Expired on September 30, 2013
TN0005452 Expired on August 31, 2008
Application for renewal received October 18, 2016

In April 2011, TVA entered into a Federal Facilities Compliance Agreement with EPA to resolve alleged violations of the Clean Air Act. As a condition of that agreement, TVA is required to submit updated NPDES applications for its plants that are equipped with wet flue gas desulfurization (FGD) systems to include legally-applicable requirements of the revised Effluent Limitations Guidelines related to wet FGD wastewaters within 12 months after publication on November 2, 2016.

Per a July 2016 Settlement Agreement for permit appeal between Sierra Club, et.al., TVA, and TDEC, TVA submitted the NPDES permit renewal application prior to November 2, 2016. An October 2017 revision to the Agreement states TDEC will place a draft NPDES permit on public notice by November 1, 2017.

[1] Contact Info – Robert.alexander@tn.gov, 615-532-0659

Watershed Scheduling
Environmental Field Office: Knoxville
Primary Longitude: - 84.504167 Primary Latitude: 35.904167
Hydrocode: TN06010207001-1000 Watershed Group: 5
Watershed Identification: Lower Clinch
Target Reissuance Year: 2018

III. FOSSIL PLANT OPERATIONAL DISCHARGES

A. Overview

The TVA-Kingston Fossil Plant (hereafter KIF) plant has 9 coal-fired units with a combined rated capacity of 1,700 megawatts. Wastewater originates from the process of generation of electric power from a fossil-fueled steam-electric plant and discharges to the Clinch River.

Location	Flow	Characteristics
Outfall 001	14 MGD	treated ash pond effluent consisting of bottom ash transport water, coal yard runoff including coal storage area drainage, utility building area drainage, and fire protection flushes; combustion residual leachate; chemical and nonchemical metal cleaning wastes; ammonia storage area runoff; water treatment plant wastes including RO system reject and backwash; drainage from sluice line trench; station sump discharge including ash system leakage and boiler bottom overflow and fan bearing cooling water, equipment cooling and lubricating water, fire protection flushes, floor washing, roof drains and precipitator washdown, boiler water leakage, analytical process wastewater, basement boiler blowdown, and lab sample stations; stormwater from FGD area sump; and AAF area sump with precipitator wash and raw water leakage
Outfall 002	999 MGD	once-through condenser cooling water discharge plus flows from Outfall 001; boiler blowdown; discharge from underflow ponds with fire protection flushes, raw water leakage and transformer/switchyard runoff; intake screen backwash from Outfall 004 and FGD strainers; discharge from FGD stormwater pond IMP 01A; and discharge from Outfall 006
Outfall 004	0.25 MGD	Intake screen backwash (raw river water)
Outfall 006	0.2 MGD	Elec. Control bldg. AC condensate, fire protection flushes, and plant water leakage
IMP* 01A	1.6 MGD	Pond at FGD dewatering facility and combustion residual leachate from peninsula area FGD and ash landfill
Outfall 01B	N/A	Emergency overflow from pond at FGD/landfill only during probable maximum precipitation event
IMP* 005	Variable	Metal Cleaning wastewater

*IMP = Internal Monitoring Point

Permit documents including the renewal application are available online at the DWR Dataviewer, http://environment-online.tn.gov:8080/pls/enf_reports/f?p=9034:34001 (search both for permit numbers TN0080870 and TN0005452 for the complete facility history).

Proposed significant changes to the previous permit

- Deletion of Outfall 007, former redwater seep from the ballfield area, which was redirected in 2015 to the process water basin/stilling pond influent channel;
- Deletion of Outfall 008, discharge from concrete-lined sluice trench, which has been rerouted to the process water basin /stilling pond influent channel; and
- This permit incorporates monitoring and effluent limitations from TN0080870 for IMP 01A, dealing with dewatered FGD wastewater and wastewater from the "peninsula" landfill.

B. Stormwater

Except for incidental rainfall on facility ponds and stormwater discharges summarized on the cover page of this permit, stormwater discharges associated with the industrial activity from this facility are covered by the Tennessee Multi-Sector General Storm Water Permit, tracking number TNR051787. For more information, see DWR Dataviewer at: http://environment-online.tn.gov:8080/pls/enf_reports/f?p=9034:34051:::NO:34051:P34051_PERMIT_NUMBER:TNR051787.

C. Seeps

NPDES permit application identified seeps at 3 locations at the facility:

- at the stilling pond dike near the plant water intake on the Emory River; (The stilling pond is scheduled for closure in 2017-18.)
- near the cooling water intake on the intake channel at the sluice trench, and (Closure of the sluice trench is ongoing and scheduled for completion in 2017.)
- At the FGD process water basin dike on the Clinch River.

III. RECEIVING WATER QUALITY

The Clinch River is a part of the TVA Watts Bar Reservoir, which extends upstream approximately 20 river miles on the Clinch River and 12 miles on the Emory River and downstream approximately 38 river miles to Watts Bar Dam. The ash pond/gypsum pond discharge mixes with approximately 1 billion gallons per day of fossil plant cooling water which is pumped from the Emory River/Clinch River embayment of the reservoir. As identified in TDEC in *2014 305(b) Report: Status of Water Quality in Tennessee*[2], waters of the Clinch River arm of Watts Bar Reservoir are assessed using all available monitoring data. A summary of the assessment information is presented in the table below:

TDEC Assessment	Classified Uses
Fully Supporting	Domestic Water Supply, Industrial Water Supply, Fish and Aquatic Life, Irrigation, and Livestock Watering and Wildlife
Not Supporting	Recreation (due to contaminated sediments and upstream industrial discharges from DOE Oak Ridge facilities, and from atmospheric deposition of mercury)

[2] This publication serves to satisfy the biennial report of the status of water quality in Tennessee required by The Clean Water Act, Section 305(b) (US Congress, 2002) and the Tennessee Water Quality Control Act (Tennessee Secretary of State, 1999). http://www.tn.gov/assets/entities/environment/attachments/wr_wq_report-305b-2014.pdf. Additional information on the stream assessment process is found in the 305b Report, Chapter 1, Water Quality Assessment Process at page 13, et. seq.

2017 Assessment, Clinch River arm of Watts Bar Reservoir

Go Actions

- ID305b (GIS Link) = 'TN06010207001_1000'
- ID305b (GIS Link)
- Use Desc
- Not Supporting
- Supporting

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ID305b (GIS Link) : TN06010207001_1000, Use Desc : Domestic Water Supply

Water Name	Location Description	Cause Name	Source Name	Attainment Desc	Assmnt Date	User Flag	Current cycle
Clinch River Arm of Watts Bar Reservoir	Clinch River Arm of the Watts Bar Reservoir on the Tennessee River (Does not include the Poplar Creek embayment.) Roane County	-	-	Fully Supporting	13-MAY-16	-	2017

ID305b (GIS Link) : TN06010207001_1000, Use Desc : Fish and Aquatic Life

Water Name	Location Description	Cause Name	Source Name	Attainment Desc	Assmnt Date	User Flag	Current cycle
Clinch River Arm of Watts Bar Reservoir	Clinch River Arm of the Watts Bar Reservoir on the Tennessee River (Does not include the Poplar Creek embayment.) Roane County	-	-	Fully Supporting	13-MAY-16	-	2017

ID305b (GIS Link) : TN06010207001_1000, Use Desc : Industrial Water Supply

Water Name	Location Description	Cause Name	Source Name	Attainment Desc	Assmnt Date	User Flag	Current cycle
Clinch River Arm of Watts Bar Reservoir	Clinch River Arm of the Watts Bar Reservoir on the Tennessee River (Does not include the Poplar Creek embayment.) Roane County	-	-	Fully Supporting	13-MAY-16	-	2017

ID305b (GIS Link) : TN06010207001_1000, Use Desc : Irrigation

Water Name	Location Description	Cause Name	Source Name	Attainment Desc	Assmnt Date	User Flag	Current cycle
Clinch River Arm of Watts Bar Reservoir	Clinch River Arm of the Watts Bar Reservoir on the Tennessee River (Does not include the Poplar Creek embayment.) Roane County	-	-	Fully Supporting	13-MAY-16	-	2017

ID305b (GIS Link) : TN06010207001_1000, Use Desc : Livestock Watering and Wildlife

Water Name	Location Description	Cause Name	Source Name	Attainment Desc	Assmnt Date	User Flag	Current cycle
Clinch River Arm of Watts Bar Reservoir	Clinch River Arm of the Watts Bar Reservoir on the Tennessee River (Does not include the Poplar Creek embayment.) Roane County	-	-	Fully Supporting	13-MAY-16	-	2017

ID305b (GIS Link) : TN06010207001_1000, Use Desc : Recreation

Water Name	Location Description	Cause Name	Source Name	Attainment Desc	Assmnt Date	User Flag	Current cycle
Clinch River Arm of Watts Bar Reservoir	Clinch River Arm of the Watts Bar Reservoir on the Tennessee River (Does not include the Poplar Creek embayment.) Roane County	Polychlorinated biphenyls	Contaminated Sediments	Not Supporting	13-MAY-16	-	2017
Clinch River Arm of Watts Bar Reservoir	Clinch River Arm of the Watts Bar Reservoir on the Tennessee River (Does not include the Poplar Creek embayment.) Roane County	Mercury	Industrial Point Source Discharge	Not Supporting	13-MAY-16	-	2017
Clinch River Arm of Watts Bar Reservoir	Clinch River Arm of the Watts Bar Reservoir on the Tennessee River (Does not include the Poplar Creek embayment.) Roane County	Chlordane	Contaminated Sediments	Not Supporting	13-MAY-16	-	2017
Clinch River Arm of Watts Bar Reservoir	Clinch River Arm of the Watts Bar Reservoir on the Tennessee River (Does not include the Poplar Creek embayment.) Roane County	Mercury	Atmospheric Deposition - Toxics	Not Supporting	13-MAY-16	-	2017

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Upstream pollutant sources are identified as industrial point sources and contaminated sediments primarily from upstream Department of Energy (DOE) facilities, and atmospheric deposition of mercury. A fish advisory is established for consumption of PCBs. The advisory states that "Catfish, striped bass and hybrid (striped bass-hybrid bass) should not be eaten. Precautionary advisory for white bass, sauger, carp, smallmouth buffalo, and largemouth bass" indicates "Children, pregnant women, and nursing mothers should not consume the fish species named. All other persons should limit consumption of the named species to one meal per month."

Upstream sources including DOE facilities have been identified with elevated levels of mercury in fish tissue in waters immediately upstream of the Kingston plant. Mercury in fish tissue at levels > 0.3 ppm is documented in the Clinch River arm of Watts Bar Lake at mile 11.0 and in Poplar Creek, which enters the Clinch River at RM 12, due to legacy CERCLA releases.[3] Additional information on the 303(d) list is found at http://www.tn.gov/assets/entities/environment/attachments/wr_wq_303d-2016-draft-revisions.pdf.

Water quality conditions described above, i.e., mercury and PCBs in fish tissue, have not been attributed in the past to TVA Kingston discharges described in this permit. Although discharges from the TVA site containing mercury potentially contribute to fish tissue levels, historic data points to legacy problems from upstream DOE sources. No means currently exists to differentiate mercury levels now found in fish tissue with respect to DOE and TVA loadings.

No Federally-listed threatened and endangered species or designated critical habitat are known to exist in the vicinity of the KIF cooling water intake. TDEC has not designated the receiving stream as Exceptional TN Waters, and the decision was based on:

- Review by the TN Natural Heritage Program and TDEC Div. of Natural Areas;
- Communications with USFWS and TN Wildlife Resources Agency.

Water Data updated from CERCLA Ash Spill Recovery Project, January 2017

Conditions for water column, biological community and habitat have returned to pre-ash spill conditions of 2008. Levels of Se in fish tissue of bluegills and red-ear sunfish are still detectably higher than the reference sites, but still well below levels of concern for fish health or human consumers. Similarly for benthic macroinvertebrates, levels of Se and As are higher than at the reference conditions, but pose no threat to biological community or recreation. Levels of ash-related metals in reservoir sediments are a little higher in some places than the reference sites, but nothing of concern to ecology or recreation, and nothing that would trigger the need for additional clean-up.

See https://www.epa.gov/tn/epa-response-kingston-tva-coal-ash-spill and https://semspub.epa.gov/work/04/11015837.pdf (biota monitoring data 2009-2014) for more information.

[3] USDOE *2015 Remediation Effectiveness Report* for Oak Ridge Facilities, DOE/OR/01-2675&D2, page 7-11 available at http://doeic.science.energy.gov/Uploads/A.0100.064.2384.pdf

Summary of WQ and KIF Mixing Zone monitoring for metals

A comparison of metals concentrations measured at the KIF intake and effluent, as well as in-stream (upstream and in the mixing zone effluent) indicates compliance with TN Water Quality Criteria, as shown in the following table. Significant points shown by these data are:

- **No exceedances** of published TDEC WQC for metals in the water column are evident in the mixing zone downstream of KIF at Clinch RM 2.3.
- Metals concentrations measured at the KIF intake of combined Emory and Clinch River waters **closely match upstream concentrations** at Clinch RM 10.0, which is the DWR ambient monitoring station.
- At Outfall 001, **notable reductions in metals loading** are evident in 2016 data as compared to 2008 data, from permit renewal application EPA Form 2C, due to TVA's cessation of sluicing fly ash in 2009.
- Period of TDEC data for mixing zone is shown from 2008-2010 during response to the ash spill ambient monitoring.

Units are in µg/L	KIF Intake Form 2C		KIF 001 Form 2C			KIF 001 Form 2C		Upstream Amb. Clinch RM 10.0		KIF Mixing Zone Clinch RM 2.3		TN WQC			Units are in µg/L
Parameter	SYM	2016	SYM	2008	2009	SYM	2016	2008-2017		2008-2010		DWS	F&AL* CCC	W&OC	Parameter
Aluminum		155		800			312		124		335				Aluminum
Antimony	<	2		2.2		<	2					**6.0**		**5.6**	Antimony
Arsenic	<	2		22	SLUICING FLY ASH CEASED		3.22		1		3.1	**10.0**	**150**	**10.0**	Arsenic
Barium		41		380			76					**2000**			Barium
Beryllium	<	1	<	1		<	1					**4.0**			Beryllium
Boron		68		450			105								Boron
Cadmium	<	1	<	0.5		<	1		0.04		0.77	**5.0**	**0.3**		Cadmium*
Chromium		0.5		12			0.5		0.6		0.74	**100 tot**	**74 Cr3**		Chromium III
Copper		2		2.6			3.4		0.87		3		**9.0**		Copper*
Iron		169		120			179		148		267				Iron
Lead		0.2	<	1			0.5		0.43		0.32	**5.0**	**2.5**		Lead*
Magnesium		11400		13000			11000		35		48				Magnesium
Manganese		77		16			48.5								Manganese
Mercury †		0.004	<	0.2			0.003	<	0.03	<	0.047	**2.0**	**0.8**	**0.05**	Mercury
Molybdenum	<	50		43		<	50								Molybdenum
Nickel	<	2		5.3		<	2		1.1		2.3	**100**	**52**	**610**	Nickel*
Selenium	<	2		8.4		<	2	<	1.3	<	1.3	**50.0**	**5.0**	**170**	Selenium
Silver ŧ	<	1.5	<	0.5		<	0.5						**3.2 CMC**		Silver*
Thallium ₸	<	2	<	1		<	2					**2.0**		**0.24**	Thallium
Tin	<	50		42		<	50								Tin
Titanium	<	50		18		<	50								Titanium
Zinc	<	10		18			10.5		4		5.1		**120**	**7400**	Zinc*
												-- Per November 2015 Revisions'			
												*function of total hardness, based on 100 mg/			

IV. PREVIOUS PERMIT LIMITS AND MONITORING REQUIREMENTS

Appendix 1 lists the permit limitations and monitoring requirements as defined in the previous permit. The previous (existing) permit is available from the DWR Dataviewer, available at http://environment-online.tn.gov:8080/pls/enf_reports/f?p=9034:34001. The permit document can be viewed in the eDocuments section by filtering for file type = "Permits."

V. HISTORICAL MONITORING AND INSPECTION

The 2015 Compliance Inspection Report reported the facility to be in compliance with permit terms and conditions.

VI. APPLICABLE EFFLUENT LIMITATIONS GUIDELINES (ELGS)

Overview

Under the revised ELG rule, TDEC must set limits on wastewater streams with applicability dates. The regulated wastewater streams include wet FGD wastewaters, fly ash transport waters, combustion residuals leachate, and bottom ash transport waters. These applicability dates must be "as soon as possible beginning November 1, 2018, but no later than December 31, 2023" for fly ash transport waters and "as soon as possible beginning November 1, 2020, but no later than December 31, 2023" for bottom ash transport waters and FGD wastewaters. Permit limits for ELGs for Coal Combustion Residuals [seepage and/or leakage from a combustion residual landfill or impoundment unit] must also be established in this permit.

Interim and final limits are discussed in Section VIII below for each wastewater stream at Outfalls 001 and IMP 01A. TVA provided updated information in October 2017 to support development of applicability dates – this information is attached to this Rationale in Appendix 3.

The compliance schedule in Part I of the permit establishes the applicable dates for compliance with interim limits until December 1, 2023. Where applicability dates for final limits extend beyond the 5-year permit term, EPA rules at § 122.47 and TDEC rules are equivalent to the "as soon as possible" requirement.

40 CFR rule citations are as follows.

- § 423.11(t): defines "as soon as possible" to be November 1, 2018, unless the permitting authority establishes a later date based on factors that include certain Clean Air Act regulations, the CCR rule, FGD wastewater treatment system optimization, and other factors "as appropriate."
- § 423.13(g)(1)(i): contains the BAT requirements for FGD wastewater, including the new limits for arsenic, mercury, selenium, and nitrate/nitrite.
- § 423.13(h)(1)(i): contains the BAT "no discharge" provision for fly ash transport water.
- § 423.13(i)(1)(i): contains the BAT "no discharge" provision for FGMC wastewater.
- § 423.13(j)(1)(i): contains the BAT limits for gasification wastewater.
- § 423.13(k)(1)(i): contains the "no discharge" provision for bottom ash transport water.

Background

On January 4, 2016, the EPA final rule for Effluent Limitation Guidelines for the Steam Electric Power Generating Point Source Category[4] became effective. By a letter to the TDEC Commissioner dated April 11, 2017, the Administrator announced the EPA decision to consider two petitions to reconsider the final rule that amends the effluent limitation guidelines and standards for the steam electric point source category. The next day, the Administrator issued a letter announcing that EPA will reconsider the final rules. The letter also stated the agency was acting promptly to issue an administrative stay of compliance deadlines that had not yet passed and that it was intending to request a stay from the Fifth Circuit Court of Appeals for 120 days

[4] Published at 80 Fed. Reg. 67838 (November 3, 2015).

by which time it intended to inform the court of the portions of the rule, if any, it intends to have remanded to the agency for further rulemaking. Lastly, Mr. Pruitt stated that because an administrative stay lasts only as long as the judicial review, EPA intended to conduct rulemaking during reconsideration of the rules to stay or amend compliance deadlines.

On April 24, 2017, the Fifth Circuit Court of Appeals[5] granted EPA's motion to stay further proceedings. The court also granted EPA's motion to file a motion to govern further proceedings to inform the court if it wishes to seek a remand of any provisions of the rule by August 12, 2017.

In the April 25, 2017 *Federal Register* notice, EPA stated it was postponing the compliance dates that have not yet passed pending judicial review. 82 Fed. Reg. 19005. This postponement comes under Section 705 of the Administrative Procedures Act (APA), which allows an agency to postpone the effective date of action taken by it pending judicial review. The Agency continued by explaining that the postponement "will preserve the regulatory status quo with respect to wastestreams subject to the Rule's new, and more stringent limitations and standards, while litigation is pending and the reconsideration is underway." *Id*. at 19005.

On June 6, 2017, EPA issued a proposed rule in the Federal Register to postpone certain compliance dates in the ELGs and standards for the steam electric point source category. EPA reiterated that it intended to postpone specifically the compliance deadlines for the new best available technology economically achievable effluent limitations and pretreatment standards for fly ash transport water, bottom ash transport water, flue gas desulfurization wastewater, flue gas mercury control wastewater, and gasification wastewater. EPA intends to postpone these compliance dates until it completes reconsideration of the 2015 ELGs. The Agency made reference to the earlier Federal Register notice concerning postponement of these compliance dates pursuant to the APA and distinguished it as postponement of the effective date of an action pending judicial review. The rulemaking anticipated postponing the compliance dates in the event the litigation ended and the Agency undertook reconsideration of the rules. It iwas EPA's intent to postpone the compliance dates until it promulgated a final rule specifying compliance dates.

On August 22, 2017, the Fifth Circuit Court of Appeals granted EPA's motion to sever and hold in abeyance all judicial proceedings as to all issues relating to the portion of the 2015 Rule concerning the new, more stringent limitations and PSES applicable to (1) bottom ash transport water, (2) FGD wastewater, and (3) gasification wastewater pending Respondents' completion of further agency action.

On September 28, 2017, EPA published a Final Rulemaking that postponed compliance dates for the FGD and Bottom Ash Transport Water to November 2020 pending further EPA rulemaking[6]. The compliance date of 2023 remains in effect.

Reopener

As defined by EPA rules and Part I of the Permit, should any future rulemaking establish revised ELGs, the permit would be reopened. TDEC NPDES permit standard Reopener language is:

> *If an applicable standard or limitation is promulgated under Sections 301(b)(2)(C) and (D), 304(B)(2), and 307(a)(2) and that effluent standard or limitation is more*

[5] *Southwestern Elec. Power Co., et al. v. EPA, et al.*, No. 15-60821 (5th Cir

[6] Updated and postponed dates are described at 82 Fed. Reg. 43,494 (September 28, 2017).

stringent than any effluent limitation in the permit or controls a pollutant not limited in the permit, the permit shall be promptly modified or revoked and reissued to conform to that effluent standard or limitation. [40 CFR 122.62(7)].

2016 Settlement Agreement with Citizens Groups

In July 2016, TDEC, TVA, and citizens' groups entered into a settlement agreement concerning permit appeals for the TVA Bull Run, Gallatin, and Kingston facilities. As part of that settlement, TDEC agreed to make permit decisions on the pending applications by December 31, 2017.

Furthermore, in the renewed permits, TDEC agreed to require TVA to implement the ELGs at the plants between November 1, 2018, and December 31, 2023. The settlement agreement provides, in part, that if there is a subsequent change in law, through voluntary action by EPA, that alters any of TDEC's obligations concerning the matters addressed in the Agreement, then the Agreement will be considered to have been amended to conform to such changes without further action of the parties. (Para. 8). In a revised Agreement of October 2017, TDEC will place the draft permits on public notice as follows: KIF on November 1, 2017, Bull Run Fossil on January 1, 2018, and Gallatin Fossil on February 1, 2018.

FGD Wastewater

In addition to the BPT limits, the 2015 Steam Electric ELGs also established the first national BAT effluent limitation guidelines for FGD wastewater. These BAT limits are based on wastewater treatment using chemical precipitation followed by biological treatment. The new BAT standards for FGD wastewater, 40 C.F.R. § 423.13(g), state as follows:

40 CFR 423.(g)(1)

(i) FGD wastewater. Except for those discharges to which paragraph (g)(2) or (g)(3) of this section applies, the quantity of pollutants in FGD wastewater shall not exceed the quantity determined by multiplying the flow of FGD wastewater times the concentration listed in the table following this paragraph (g)(1)(i). Dischargers must meet the effluent limitations for FGD wastewater in this paragraph by a date determined by the permitting authority that is as soon as possible beginning November 1, 2018, but no later than December 31, 2023. These effluent limitations apply to the discharge of FGD wastewater generated on and after the date determined by the permitting authority for meeting the effluent limitations, as specified in this paragraph.

Pollutant or pollutant property	BAT effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed
Arsenic, total (ug/l)	11	8
Mercury, total (ng/l)	788	356
Selenium, total (ug/l)	23	12
Nitrate/Nitrite as N (mg/l)	17	4.4

(ii) For FGD wastewater generated before the date determined by the permitting authority, as specified in paragraph (g)(1)(i), the quantity of pollutants discharged in FGD wastewater shall not exceed the quantity determined by multiplying the flow of FGD wastewater times the concentration listed for TSS in § 423.12(b)(11).

These effluent limitations provide the BAT standards that are applicable at KIF. Effective September 28, 2017, EPA delayed the applicability date of November 1, 2018 to November 1, 2020 pending further rulemaking. The compliance deadline of December 1, 2023 remains in effect.

Interim Limits for FGD Wastewater at Outfall 01A

For wastewaters generated prior to December 1, 2023, BAT effluent limits are based on BPT limits for TSS in 40 CFR 423.12(b)(11).

Pollutant or pollutant property	BPT effluent limitations	
	Maximum for any 1 day (mg/l)	Average of daily values for 30 consecutive days shall not exceed (mg/l)
TSS	100.0	30.0

Final Limits for FGD Wastewater – applicable December 1, 2023 – at IMP 009
Internal Monitoring Point (IMP) 009 will be established for documentation of compliance.

Pollutant or pollutant property	BAT effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed
Arsenic, total (ug/l)	11	8
Mercury, total (ng/l)	788	356
Selenium, total (ug/l)	23	12
Nitrate/Nitrite as N (mg/l)	17	4.4
TSS	100.0	30.0
Oil and grease	20.0	15.0

Bottom Ash Transport Water at Outfall 001

Interim limits are based on ELGs for Bottom Ash Transport Water. TSS and Oil and Grease BPT limits for bottom ash transport water have not changed. The 2015 ELGs at 40 CFR 423.13 (k)(1)(ii) place an interim limit equivalent to the TSS limit in 40 CFR 423.12 (b)(4) requirements.

40 CFR 423.12 (b)(4) states "*The quantity of pollutants discharged in fly ash and bottom ash transport water shall not exceed the quantity determined by multiplying the flow of fly ash and bottom ash transport water times the concentration listed in the following table:*

Pollutant or pollutant property	BPT effluent limitations	
	Maximum for any 1 day (mg/l)	Average of daily values for 30 consecutive days shall not exceed (mg/l)
TSS	100.0	30.0
Oil and grease	20.0	15.0

Monitoring frequency shall be monthly from a grab sample.

These interim limits apply to any discharge of bottom ash transport water that occurs *prior to* the final compliance deadline of December 1, 2023.

Final Limits for Bottom Ash Transport Water at Outfall 001

Bottom ash transport water. Except for those discharges to which paragraph 40 CFR 423.12 (k)(2) applies, or when the bottom ash transport water is used in the FGD scrubber, **there shall be no discharge of pollutants in bottom ash transport water**.

Combustion Residual Leachate at Outfalls 001 and 01A

For KIF wastewaters, the rules were not proposed to be stayed for limits on coal combustion residual leachate. The ELGs from 1982 were unchanged in the revised 2015 ELGs and are currently applicable *[423.12(b)(11)].*

BPT Limits on combustion residual leachate (total suspended solids (TSS), oil and grease (O&G) and pH) apply on the effective date of issuance of this renewed permit and are shown below at the discussion of Outfall 001 and 01A. The BAT limit for TSS is equivalent to 423.13 (l).

Pollutant or pollutant property	BPT effluent limitations	
	Maximum for any 1 day (mg/l)	Average of daily values for 30 consecutive days shall not exceed (mg/l)
TSS	100.0	30.0
Oil and grease	20.0	15.0

Metal Cleaning Wastes at IMP 005

1. Limits for metal cleaning wastes are applicable on the effective date of the permit.
2. Limits on **chemical** metal cleaning wastes remain applicable for TSS, pH, O&G, copper and iron. *[40 CFR 423.12 (b)(5)*

Pollutant or pollutant property	BPT effluent limitations	
	Maximum for any 1 day (mg/l)	Average of daily values for 30 consecutive days shall not exceed (mg/l)
TSS	100.0	30.0
Oil and grease	20.0	15.0
Copper, total	1.0	1.0
Iron	1.0	1.0

Limits on nonchemical metal cleaning wastes remain "Reserved" in the revised ELGs. In this permit renewal, limits are established based on the permit writer's BPJ considering previous NPDES permit in which non-chemical metal cleaning wastes were treated as Low-Volume wastes subject to limits for TSS, pH, O&G.

Pollutant or pollutant property	BPT effluent limitations	
	Maximum for any 1 day (mg/l)	Average of daily values for 30 consecutive days shall not exceed (mg/l)
TSS	100.0	30.0
Oil and grease	20.0	15.0

Legacy Wastewater

Pursuant to the 2015 ELG Rule, there are limits that apply to the affected wastestreams . The Rule's legacy wastewater provisions are not proposed to be stayed. The Rule defines "legacy wastewater" as "*FGD wastewater, fly ash transport water, bottom ash transport water, flue gas mercury control wastewater, or gasification wastewater generated prior to the date determined by the permitting authority that is as soon as possible beginning November 1, 2018, but no later than December 31, 2023*."[7]

According to the 2015 ELG Rule, the BAT legacy wastewater limits apply to wastewater generated before the applicability date set by the permit writer for the waste stream in question to meet the final BAT limits. Thus, the legacy wastewater BAT limits apply to wastewater generated before the applicability date.

The legacy wastewater provision for KIF wastestreams is listed in the table below.

Wastestream	Legacy Wastewater Provision Establishing BAT	Applicability Date
FGD Wastewater	§ 423.13(g)(1)(ii)	December 1, 2023
Fly Ash Transport Water	§ 423.13(h)(1)(ii)	November 1, 2018
Bottom Ash Transport Water	§ 423.13(k)(1)(ii)	December 1, 2023

[7] 80 Fed. Reg. 67,838, 67,854 (Nov. 3, 2015).

SUMMARY

Applicability dates and technology-based permit limits for regulated wastewater streams are established in this permit. Should EPA rulemaking during the permit term create new compliance requirements, TDEC will reopen the permit to address ELGs in effect at that time.

TDEC grants TVA's requested applicability date and determines that, pursuant to the currently effective 40 CFR 423.13(k)(1)(i), the no-discharge limitation on pollutants in bottom ash transport waters should be applied on December 1, 2023. TDEC acknowledges that EPA is undertaking reconsideration of the no-discharge limit for bottom ash transport water. Regarding the selected applicability date, TDEC will take appropriate account of any changes to 40 CFR 423.13(k) or other relevant portions of 40 CFR Part 423 that result from EPA's reconsideration.

VII. KINGSTON FOSSIL PLANT WASTEWATER

a. *Bottom Ash Wastewater*

Since 2009, TVA has converted the Kingston operations to dry ash handling except for bottom ash, for which a dewatering facility is being built. In conjunction with the dewatering project, TVA installed an interim tank-based bottom ash dewatering system in early fall of 2015 and is currently installing a remote submerged flight conveyor system and belt press system.

The filtrate from bottom ash dewatering discharges through the process water pond at Outfall 001 – see Outfall 001 description in Section VIII below.

b. *FGD wastewater*

FGD wastewater is generated from operation of two once-through, high-flow wet scrubbers, with an approximate flow of 0.92 MGD. Treatment of the filtrate from gypsum dewatering includes coagulation, flocculation, settling, neutralization prior to discharge to the IMP 01A which flows to the cooling water channel and Outfall 002.

As noted above, TDEC issued in 2009 a separate NPDES permit TN0080870 for the FGD discharge upon startup, and this renewed permit incorporates FGD wastewater provisions.

c. *Fly Ash transport water*

TVA has achieved compliance with the no-discharge ELG standard for fly ash transport water. Sluicing of KIF fly ash ended in 2009 with conversion to a dry fly ash handling system, reducing the wastewater flow by over 25 MGD. Dry fly ash is placed in the peninsula area landfill.

d. *General Plant Flows*

Fossil plant operations contributing wastewater flows are discharged through Outfalls 001 and 01A. The following supplementary information provided with the October 2016 permit application is relevant:

> *In addition to wet FGD wastewater and fly ash and bottom ash transport waters, the KIF facility includes a number of other general plant flows. TVA is using the term general plant flows to refer to several types of wastewater including coal pile runoff, low volume wastes, combustion residual leachate, and chemical and nonchemical metal cleaning wastes with established ELGs. The ELG does not allow the permitting authority to*

determine future applicability dates for these flows but they are included in this document for completeness.

Much of the plant's general plant flows are currently collected and treated in the site's [process water] ash pond that discharges via Outfall 001 to the plant intake and eventually to the Clinch River. …. In addition, some general plant flows are routed to the process water [stormwater] pond at the Gypsum Disposal Facility and discharged via IMP 01A. If necessary, additional WWT may be applied or augmented at these basins in the future such as pH control or polymer injection, with appropriate state approval of the additives and/or treatment.

Chemical metal cleaning wastes will be either collected in frac tanks and any hazardous portions will be disposed of as hazardous wastes, or they will be evaporated in the boilers if allowed. If collected and not evaporated, the non-hazardous fraction of chemical cleaning wastes will be discharged in accordance with limits in the NPDES permit on TSS, O&G, pH, copper, and iron.

[Note: the permit retains IMP 005 for Metal Cleaning Wastewaters. IMP005 formerly was the location for discharge from the Chem Ponds which were eliminated during the CERCLA project in 2009.]

Non-chemical metal cleaning wastes will continue to be discharged in accordance with historical limits in the NPDES permit. As established in the ELGs and prior NPDES permits, non-chemical metal cleaning wastes were formerly treated as low volume wastes subject only to TSS, O&G and pH limitations and not copper and iron limitations.

Effluent limits data sets for IMP 005 are shown in Section VIII below.

VIII. NEW PERMIT LIMITS AND MONITORING REQUIREMENTS

Parameters and permit limits for each outfall are described below. Biomonitoring requirements are discussed in Section IX.

A. OUTFALL 001 – PROCESS WATER BASIN

KIF discharges treated bottom ash sluice waters, chemical and nonchemical metal cleaning wastes, and general plant flows including pumping basin discharges with storm water runoff from the coal pile and utility building areas, water treatment plant wastes, station sump discharges including ash system leakage and boiler bottom overflow, floor washing wastewater, miscellaneous equipment cooling and lubricating water, boiler makeup water leakage, analytical process water, roof drains, and precipitator washdown water discharges Treated wastewater discharges from Outfall 001 to the intake channel on Emory River.

Sluicing of fly ash into the ash pond was discontinued in 2009-10 such that some parameters, primarily ammonia nitrogen, from the previous permit are not applicable.

Non-chemical metal cleaning wastes, which have been historically managed as low-volume wastes and treated by impoundment, will continue to be managed in this manner. Reporting for TSS and Oil and Grease as applicable for ELGs for low-volume wastes are required at Outfall 001.

PARAMETERS TO BE INCLUDED AS **INTERIM** PERMIT LIMITS

Oil & Grease and Total Suspended Solids (TSS) – ELG limits apply

For Oil and Grease, daily maximum (20 mg/l) and monthly average (15 mg/l) limits apply. For TSS, daily maximum (100 mg/l) and monthly average (30 mg/l) limits apply.

pH

The pH range limit of 6.0 to 9.0 will be retained for the discharge from Outfall 001. This would ensure the protection of water quality and, likewise, follow the federal guidelines promulgated by the EPA in 40 CFR §423.12(b)(1) which states "The pH of all discharges, except for once through cooling water, shall be in the range of 6.0 to 9.0." pH monitoring frequency at Outfall 001 will be retained at once per week from the previous permit.

Ammonia, Nitrogen Total - deleted

Selective Catalytic Reduction (SCR) equipment is used at KIF in order to lower nitrogen oxide stack emissions, as mandated by the Tennessee Air Quality Board. Ammonia is injected into the stack gases and ammonia compounds were formerly exposed to fly ash sluice water discharged with the ash pond effluent.

Since TVA has converted KIF to dry fly ash handling and eliminated fly ash sluice water, ammonia concentrations in the ash pond effluent are reported at <0.17 mg/l in the 2016 renewal application. This is the same concentration as found in the intake water. Accordingly, monitoring and reporting for ammonia in the renewed permit is deleted.

Metals

The polishing pond receives wastewater flows which have been in contact with coal combustion residuals (CCR) which contain metals, such as bottom ash, CCR leachate, and miscellaneous general plant flow having a minor CCR component. As shown in the following spreadsheet, metals in flows do not represent reasonable potential for exceedance of WQC in the KIF intake channel.

Calculated effluent concentrations are shown which, if exceeded, would cause an exceedance in the mixing zone and would require numeric permit limits for the parameter. **None of the reported metals in Outfall 001 are greater than this calculated value**[8]. Effluent flow value of 14 MGD is mixed with the Minimum Flow of 654 MGD for the plant intake, as discussed below at Outfall 002.

In the renewed permit, reporting is required for effluent metals concentrations at Outfall 001 pending elimination of wastewater flows involving CCR. Metals monitoring must continue until elimination of discharges from bottom ash dewatering filtrate and/or until a statistically-valid data set exists to enable revision of monitoring frequency.

Upon further effluent characterization, TVA may request a permit modification to address metals monitoring.

[8] Thallium has a WQC (0.24 ug/l) lower than available detection limits (1.0 ug/l) ; note that thallium concentration is Outfall 001 already meets the drinking water WQC as an end-of-pipe criterion.

Sheet 1 of 2

WATER QUALITY BASED EFFLUENT CALCULATIONS
OUTFALL 001

Hardness data: 130 mg/l
Clinch RM 4.5
TDEC Ambient Sta.

Stream (1Q10)	Stream (30Q5)	Waste Flow	Ttl. Susp. Solids	Hardness as CaCO3	Stream Allocation
[MGD]	[MGD]	[MGD]	[mg/l]	[mg/l]	[%]
654.0	654.0	14.00	9	130	90

	1	2	3	4	5	6	7	8
	Stream	Fish/Aqua. Life		Effluent	Fish & Aquatic Life WQ Criteria (1Q10)			
	Bckgrnd.	WQ Criteria		Fraction	In-Stream Allowable		Calc. Effluent Conc'n	
EFFLUENT	Conc.***	Chronic	Acute	Dissolved	Chronic	Acute	Chronic	Acute
CHARACTERISTIC	[ug/l]	[ug/l]	[ug/l]	[Fraction]	[ug/l]	[ug/l]	[ug/l]	[ug/l]
Aluminum	155	--	--		--	--	--	--
Antimony	2	--	--		--	--	--	--
Arsenic	2	150	340		150	340	**6357**	**14516**
Barium	39	--	--		--	--	--	--
Beryllium	1	--	--		--	--	--	--
Boron	102	--	--		--	--	--	--
Cadmium *	1	0.295	2.59	0.194	1.52	13.36	**23**	**531**
Calcium		--	--		--	--	--	--
Chromium *	0.5	706.3	33.8	0.084	8392	401	**360368**	**17204**
Cobalt	2	--	--		--	--	--	--
Copper *	0.2	11.21	17.21	0.220	51.0	78.3	**2181**	**3354**
Iron	179	--	--		--	--	--	--
Lead *	0.2	3.34	85.83	0.152	21.98	564	**936**	**24214**
Magnesium	11	--	--		--	--	--	--
Manganese	35	50	100	1.0	50.00	100	**676**	**2823**
Mercury, (T) **	0.004	0.770	1.4		0.77	1.40	**33**	**60**
Molybdenum	50	--	--		--	--	--	--
Nickel *	2	64.9	584.6	0.210	309	2784	**13196**	**119483**
Selenium	2.0	5	20	1.0	5	20	**131**	**775**
Silver *	0.5	--	5.051	1.0	--	5.05	--	**196**
Sodium		--	--		--	--	--	--
Thallium	2	--	--		--	--	--	--
Tin	50	--	--		--	--	--	--
Titanium	50	--	--		--	--	--	--
Vanadium		--	--		--	--	--	--
Yttrium		--	--		--	--	--	--
Zinc *	10	146.35	146.35	0.13	1136.38	1136.38	**48379**	**48379**
Cyanide (T)	7.0	5.2	22.0	1.0	5.2	22.0	**-71**	**650**

Sheet 2 of 2

	9	10	11	12	13	14	
	Human Health Water Quality Criteria (30Q5)						Outfall
	In-Stream Criteria			Calc. Effluent Concentration			001
EFFLUENT	Organisms	ater/Organisr	DWS	Organisms	ater/Organisr	DWS	Conc'n
CHARACTERISTIC	[ug/l]	[ug/l]	[ug/l]	[ug/l]	[ug/l]	[ug/l]	ug/l
Aluminum	--	--	--	--	--	--	895
Antimony	5.6	5.6	6.0	**156**	**156**	**174**	4.8
Arsenic	10.0	10.0	10.0	**345**	**345**	**345**	56
Barium	--	--	2000	--	--	**84246**	415
Beryllium	--	--	4.0	--	--	**130**	1.0
Boron	--	--	--	--	--	--	375
Cadmium *	--	--	5.0	--	--	**173**	0.30
Calcium	--	--	--	--	--	--	
Chromium III *	--	--	100.0	--	--	**4273**	9.50
Cobalt	--	--	--	--	--	--	5.5
Copper *	--	--	--	--	--	--	1.8
Iron	--	--	--	--	--	--	200
Lead *	--	--	5.0	--	--	**206**	2
Magnesium	--	--	--	--	--	--	12000
Manganese	--	50	100	--	**675.6**	**2823**	25.0
Mercury, (T) **	0.051	0.050	2.0	**2.0**	**2.0**	**86**	0.15
Molybdenum	--	--	--	--	--	--	65
Nickel *	4600	610	100	**197453**	**26111**	**4210**	4
Selenium	--	--	50.0	--	--	**2063**	16
Silver *	--	--	--	--	--	--	0.30
Sodium	--	--	--	--	--	--	
Thallium	0.47	0.24	2.0	**-63.9**	**-73.8**	**2**	1.5
Tin	--	--	--	--	--	--	46.0
Titanium	--	--	--	--	--	--	27.5
Vanadium	--	--	--	--	--	--	
Yttrium	--	--	--	--	--	--	
Zinc *	--	--	--	--	--	--	16.0
Cyanide (T)	140.0	140.0	200.0	**5718**	**5718**	**NA**	NA

NA = not applicable.

* Denotes metals for which Fish & Aquatic Life Criteria are expressed as a function of total hardness.The Fish & Aquatic Life criteria for this metal are in the dissolved form at laboratory conditions. The in-stream allowable criteria and calculated effluent concentrations are in the total recoverable form.

** Chronic criterion for mercury is not converted to dissolved, as it addresses bioaccumulation rather than toxicity.

*** Stream background concentrations are taken from intake sample on 2016 permit application;

except for manganese, which is upstream TDEC ambient data at RM 10.0, since app'n data considered outlier.

[reported detection levels are used when no reportable concentration exists.]

OUTFALL 001 PERMIT LIMITS AND MONITORING REQUIREMENTS

Code	Parameter	Qualifier	Value	Unit	Sample Type	Frequency	Statistical Base
00400	pH	>=	6.0	SU	Grab	Weekly	Minimum
00400	pH	<=	9.0	SU	Grab	Weekly	Maximum
00530	Total Suspended Solids (TSS)	<=	100	mg/L	Grab	Monthly	Daily Maximum
00530	Total Suspended Solids (TSS)	<=	30	mg/L	Grab	Monthly	Monthly Average
00556	Oil & Grease	<=	20	mg/L	Grab	Monthly	Daily Maximum
00556	Oil & Grease	<=	15	mg/L	Grab	Monthly	Monthly Average
01002	Arsenic, total (as As)	Report	-	mg/L	Grab	Monthly	Daily Maximum
01007	Barium, total (as Ba)	Report	-	mg/L	Grab	Monthly	Daily Maximum
01012	Beryllium, total (as Be)	Report	-	mg/L	Grab	Monthly	Daily Maximum
01027	Cadmium, total (as Cd)	Report	-	mg/L	Grab	Monthly	Daily Maximum
01034	Chromium, total (as Cr)	Report	-	mg/L	Grab	Monthly	Daily Maximum
01042	Copper, total (as Cu)	Report	-	mg/L	Grab	Monthly	Daily Maximum
01045	Iron, total (as Fe)	Report	-	mg/L	Grab	Monthly	Daily Maximum
01051	Lead, total (as Pb)	Report	-	mg/L	Grab	Monthly	Daily Maximum
01059	Thallium, total (as Tl)	Report	-	mg/L	Grab	Monthly	Daily Maximum
01067	Nickel, total (as Ni)	Report	-	mg/L	Grab	Monthly	Daily Maximum
01077	Silver, total (as Ag)	Report	-	mg/L	Grab	Monthly	Daily Maximum
01092	Zinc, total (as Zn)	Report	-	mg/L	Grab	Monthly	Daily Maximum
01097	Antimony, total (as Sb)	Report	-	mg/L	Grab	Monthly	Daily Maximum
01105	Aluminum, total (as Al)	Report	-	mg/L	Grab	Monthly	Daily Maximum
01147	Selenium, total (as Se)	Report	-	mg/L	Grab	Monthly	Daily Maximum
50050	Flow	Report	-	Mgal/d	Instantaneous	Weekly	Monthly Average
50050	Flow	Report	-	Mgal/d	Instantaneous	Weekly	Daily Maximum
	Fluoride	Report	-	mg/L	Grab	Monthly	Daily Maximum
	Boron	Report	-	mg/L	Grab	Monthly	Daily Maximum
	Calcium	Report	-	mg/L	Grab	Monthly	Daily Maximum
	Sulfate	Report	-	mg/L	Grab	Monthly	Daily Maximum
	Total Dissolved Solids	Report	-	mg/L	Grab	Monthly	Daily Maximum
	Antimony	Report	-	mg/L	Grab	Monthly	Daily Maximum
	Cobalt	Report	-	mg/L	Grab	Monthly	Daily Maximum
	Lithium	Report	-	mg/L	Grab	Monthly	Daily Maximum
	Molybdenum	Report	-	mg/L	Grab	Monthly	Daily Maximum
	Thallium	Report	-	mg/L	Grab	Monthly	Daily Maximum
	Ra^{228} and Ra^{229}	Report	-	mg/L	Grab	Monthly	Daily Maximum

2. Final Limits – Outfall 001

Bottom ash transport water. Except for those discharges to which paragraph 40 CFR 423 (k)(2) applies, or when the bottom ash transport water is used in the FGD scrubber, **there shall be no discharge of pollutants in bottom ash transport water**.

The 2015 ELGs establish a no-discharge standard for bottom ash transport water, involving a dry handling or a closed-loop system that recycles flow from the dewatering process.

TVA is both currently installing a bottom ash dewatering system and conveyor system and also planning/designing to build the recirculation system separately. These efforts are required in order to meet the Applicability Date for No-Discharge of December 1, 2023, per 40 CFR 423 (k)(1).

B. OUTFALL 002

Outfall 002 is comprised primarily of waters associated with the condenser cooling processes. From the updated permit application, the total cooling water flow is approximately 999.14 MGD which includes flow from Outfalls 001, 004, IMP005, IMP 01A FGD and landfill wastewater pond, and Outfall 006.

Total Residual Oxidants

Of particular interest with respect to this outfall is the consideration for Total Residual Oxidant, as Chlorine (Cl_2). Although KIF does not currently treat the CCW with chlorine as a biocide, the intake water may be treated with chemicals which contain bromides or other oxidants, permit limitations on the discharge of chlorine related pollutants are provided for "Total Residual Oxidants" (TRO) rather than "Total Residual Chlorine" in accordance with 40 CFR §423.11(a). Additionally, since TRO analysis methodology is not included in 40 CFR §136, for the purpose of this permit TRO measurements shall be made using the amperometric titration, DPD colorimetric, or specific ion electrode method for total residual chlorine as defined in 40 CFR §136.

In calculating the total residual oxidant limitations promulgated in this permit, the division considered the estimated stream low flows as well as the estimates of flow conditions under various "unit" operations. For the purpose of this permit, the division has assumed that the minimum operating conditions at this facility would reflect the operation of 1 unit running full open at 187 MGD (being chlorinated accordingly), 2 similar units (187 MGD each) being operated at 50% of capacity, 4 of the smaller units (140 MGD each) being operated at 50% of capacity, and 2 smaller units (140 MGD each) being held in reserve. The calculation of this minimum operating volume is as follows:

Minimum flow = (187 MGD) + 0.50 x (187 MGD x 2) + 0.50 x (140 MGD x 4) = 654 MGD

In light of the recirculating flow conditions which this facility was designed to operate under, and the fact that the estimated low flow conditions in-stream of 155.8 MGD are substantially lower than the 654 MGD necessary to maintain minimum operating conditions, the division has decided to forego any attempts to reconcile the low flow conditions of the receiving stream with the minimum water volume necessary to sustain the operations at the facility. For this reason, the division is assuming that during periods when the facility is operating during minimum capacity, and under low flow conditions, the volume of water necessary to continue operations in a recirculating system is equal to 654 MGD. Furthermore, since only 187 MGD, or 1 unit, will be allowed to be treated at one time, a dilution factor of 654 to 187, or 3.5 to 1, will be used in determining the total residual oxidant concentration allowable in the discharge from Outfall 002.

ELGs for once-through cooling water at 40 CFR 423.13 (c)(1) establish the BAT-required discharge concentration for total residual oxidant (as Chlorine) is 0.2 mg/l, and is, therefore, less stringent than the water quality based calculations using the 3.5 to 1 dilution factor and EPA in-stream concentrations of 0.011 mg/l and 0.019 mg/l for the monthly average and daily maximum, respectively. **Consequently, water quality is determinative of the total residual oxidant limits in this new permit** (See reasonable potential worksheet below).

WATER QUALITY BASED EFFLUENT CALCULATIONS
OUTFALL 002

FACILITY: TVA Kingston Fossil Plant
PERMIT #: TN0005452

Stream (1Q10)	Stream (30Q2)	Waste Flow *	Ttl. Susp. Solids	Hardness (as CaCO3)	Stream Allocation
[MGD]	[MGD]	[MGD]	[mg/l]	[mg/l]	[%]
155.8	NA	654	10	50	90

	1	2	3	4	5	6	7	8
	Stream	Fish/Aqua. Life		Effluent	Fish & Aquatic Life Water Quality Criteria (1Q10)			
	Bckgrnd.	Water Quality Criteria		Fraction	In-Stream Allowable		Calc. Effluent Concentration	
EFFLUENT CHARACTERISTIC	Conc.	Chronic	Acute	Dissolved	Chronic	Acute	Chronic	Acute
	[ug/l]	[ug/l]	[ug/l]	[Fraction]	[ug/l]	[ug/l]	[ug/l]	[ug/l]
Total Residual Oxidant	0.000	11.000	19.000	1.000	11.000	19.000	**13.6**	**23.5**

	9	10	11	12	13	14
	Human Health Water Quality Criteria (30Q2)					
	In-Stream Criteria			Calc. Effluent Concentration		
EFFLUENT CHARACTERISTIC	Organisms	Water/Organisms	DWS	Organisms	Water/Organisms	DWS
	[ug/l]	[ug/l]	[ug/l]	[ug/l]	[ug/l]	[ug/l]
Total Residual Oxidant	NA	NA	NA	**NA**	**NA**	**NA**

* This flow was used for purposes of using a a dilution factor of (654-187) to 187, or 3.5 to 1. In light of the recirculating flow conditions which this facility was designed to operate under, and the fact that the estimated low flow conditions in-stream of 155.8 MGD are substantially lower than the 654 MGD necessary to maintain minimum operating conditions, the division has decided to forego any attempts to reconcile the low flow conditions of the receiving stream with the minimum water volume necessary to sustain the operations at the facility. For this reason, the division is assuming that during periods when the facility is operating during minimum capacity, and under low flow conditions, the volume of water necessary to continue operations in a recirculating system is equal to 654 MGD. Furthermore, since only 187 MGD, or one (1) unit, will be allowed to be chlorinated at one time, a dilution factor of (654-187) to 187, or 3.5 to 1, will be used in determining the total residual oxidant concentration allowable in the discharge from Outfall 002.

NOTE: Water Quality criteria for stream use classifications other than Fish & Aquatic Life are based on the 30Q2 flow.

Biomonitoring Requirements, Chronic

The discharge of cooling water from Outfall 002 may contain several different pollutants, the combined effect of which has a reasonable potential to be detrimental to fish and aquatic life. The Tennessee Water Quality Standards criteria stipulates that "*The waters shall not contain toxic substances, whether alone or in combination with other substances, which will produce toxic conditions...*".

In accordance with EPA's recommendation (Technical Support Document for Water Quality-based Toxics Control, EPA/505/2-90-001), an effluent from Outfall 002 at Kingston Fossil Plant should retain its WET limit based on a demonstration of Reasonable Potential (RP) for excursions above the ambient water quality acute and chronic (CMC and CCC) criteria. This demonstration of RP was not due to toxicity observed in Outfall 001, but to insufficient flow in the Clinch River for mixing with the combined ash pond and condenser cooling water discharge to meet the CMC and CCC criteria of 0.3 TUa and 1.0 TUc, respectively.

The discharge is not expected to have toxic pollutants other than biocides containing oxidizers such as bromine. However, the size of the discharge has a potential for large impacts if pollutants entered the cooling water in significant amounts. Since the discharge (999 MGD)

exceeds the low flow value (1Q10=654 MGD) for the receiving stream, no significant dilution will be provided. Because of this, an IC_{25} limitation of 100% effluent will be retained in the new permit.

Therefore, WET testing will be required on 100% effluent. **The toxicity tests at Outfall 002 specified herein shall be conducted annually during a period of biocide application.**

Biocide/Corrosion Treatment Plan

The use of toxic chemicals, biocides, and slimicides at the site for process and non-process flows shall be managed under a Biocide/Corrosion Treatment Plan (B/CTP). The B/CTP shall describe chemical applications and macroinvertebrate controls; include all material feed rates, and proposed monitoring schedule(s) to verify that effluent limitations are being met and water quality is being protected. The permittee shall conduct treatments of intake or process waters under this permit using biocides, dispersants, surfactants, corrosion inhibiting chemicals, or detoxification chemicals in accordance with conditions approved and specified in the permit.

The permittee shall maintain the B/CTP at the facility and make the plan available to the permit issuing authority upon request. The permittee shall amend the B/CTP whenever there is a change in the application of the chemical additives or change in the operation of the facility that materially increases the potential for these activities to result in a discharge of significant amounts of pollutants. The division shall also be notified in writing within 30-days of any material changes that will change the active ingredients or quantities used of any such chemical additives.

Total Mercury

As required by the TN Antidegradation Statement and by the TDEC determination that the Clinch River arm of Watts Bar Reservoir is unavailable waters for mercury, the renewed permit establishes a numeric mercury limit for Outfall 002. This is required to address the discharge of FGD wastewater from IMP 01A, which is tributary to Outfall 002.

Per TDEC 0400-40-05-.10(4), effluent discharges are required to meet the anti-degradation requirements of TDEC 0400-40-03-.06 to ensure that new or increased discharges do not cause measurable degradation of any parameter that is "unavailable." Unavailable parameters exist where water quality is at, or fails to meet, the levels specified as water quality criteria in TDEC 0400-40-03-.03. Specifically:

> *"… nor will discharges be authorized if they cause additional loadings of unavailable parameters that are bioaccumulative." [*TDEC 0400-40-03-.06(2)(a)]

Accordingly, the "no additional loading" requirement applies to the WQ criterion for the Recreation use classification at end-of-pipe. At Outfall 002 the permit limit for Total Mercury is the water column concentration of 0.051 ug/l (or 51 ng/l), to be reported from a grab sample collected monthly.

PROPOSED LIMITS – OUTFALL 002

Description : External Outfall, Number : 002, Monitoring : Effluent Gross, Season : All Year

Code	Parameter	Qualifier	Value	Unit	Sample Type	Frequency	Statistical Base
00010	Temperature, water deg. C	<=	36.1	deg C	Calculated[9]	Daily	Daily Maximum
50050	Flow	Report	-	Mgal/d	Pump Log	Daily	Daily Maximum
50050	Flow	Report	-	Mgal/d	Pump Log	Daily	Monthly Average
71900	Mercury, total (as Hg)	<=	0.051	ug/L	Grab	Monthly	Daily Maximum
TRP3B	IC25 Static Renewal 7 Day Chronic Ceriodaphnia	>=	100	%	Composite	Annual	Minimum
TRP6C	IC25 Static Renewal 7 Day Chronic Pimephales	>=	100	%	Composite	Annual	Minimum

Description : External Outfall, Number : 002, Monitoring : Intake from Stream, Season : All Year

Code	Parameter	Qualifier	Value	Unit	Sample Type	Frequency	Statistical Base
00010	Temperature, water deg. C	Report	-	deg C	Recorder –see note below	Continuous – see note below	Daily Maximum

Description : External Outfall, Number : 002, Monitoring : See Comments, Season : All Year

Code	Parameter	Qualifier	Value	Unit	Sample Type	Frequency	Statistical Base
34044	Oxidants, total residual	<=	.011	mg/L	Grab	Weekly	Monthly Average
34044	Oxidants, total residual	<=	.019	mg/L	Grab	Weekly	Daily Maximum

Monitoring and reporting of TRO at Outfall 002 shall be conducted during a period of application of oxidizing biocides to the CCW.

C. OUTFALL 004 – INTAKE SCREEN BACKWASH

No numeric limits or reporting requirements are established; discharges of intake screen backwash are limited to material present in the raw water source.

D. OUTFALL 006 HVAC CONDENSATE

Outfall 006, conveys comparatively minor waste streams: Non-contact Cooling Water (no additives used), North Parking Area Drainage, including Precipitation, discharging into the facility's intake channel. Since there is very minor flow and minimal, if any, pollutant loading,

[9] Intake temperature is measured hourly (continuously) but reported as a daily average once per day. The daily average discharge temperature shall be calculated for the cooling channel based on the 24-hour average intake temperature, 24-hour average unit load, and the 24-hour average flow through Outfall 002.

there will be no numeric effluent limitations or specific monitoring requirements established for discharges from Outfall 006.

E. IMP 01A –PROCESS WATER BASIN AT FGD DEWATERING/LANDFILL WASTEWATER

Permit requirements from IMP 01A are incorporated herein from Permit No. TN0080870, which will be terminated upon this permit's issuance.

IMP 01A discharges to condenser cooling water channel and then Outfall 002 to the Clinch River. The effluent consists of the filtrate from the FGD dewatering facility and discharge from the process water pond containing landfill wastewater pumped from the peninsula area FGD and ash landfill, combustion residual leachate from the landfill leachate collection system, plus precipitation.

Historical data is shown below taken from EPA-ICIS database for effluent metals at IMP 01A as required by the permit. These data indicate that most parameters (not selenium) comply with drinking water MCLs[10] prior to 1000:1 dilution in the condenser cooling water channel at Outfall 002:

DMR data IMP 01A – NPDES Permit TN0080870 - Units – ug/l.

Limit	Arsenic	Selenium	Mercury	Cadmium	Copper	Nickel	Zinc
09/30/2014	ND	1290	0.17	ND	ND	21.8	412
10/31/2014	ND	1400		ND	ND	29.896	461.042
11/30/2014	ND	606.958		1.28	ND	42.7	777
12/31/2014	ND	733	0.94	1.425	ND	16.7	534
01/31/2015	ND	685		1.11	ND	22.65	682
02/28/2015	ND	819		1.63	ND	21.3	363
03/31/2015	ND	395	0.06	1.96	ND	25.9	694
04/30/2015	ND	689		ND	ND	22.1	511
05/31/2015	ND	663		ND	ND	13.7	288
06/30/2015	1.52	535	0.24	ND	ND	16.2	177
07/31/2015	ND	307		1.48	ND	19.9	389
08/31/2015	ND	921		1.39	ND	16.4	513
09/30/2015	ND	403	1.93	ND	ND	30.5	606
10/31/2015	ND	606		ND	ND	33.6	953.5
11/30/2015	ND	381		4.3	ND	41.9	1150
12/31/2015	ND	326	1.36	1.56	ND	42.7	586
01/31/2016	ND	203		ND	ND	32.7	499
02/29/2016	ND	205		3.84	ND	11.4	128
03/31/2016	38.6	76.6	0.55	16.8	ND	25.6	450
04/30/2016	ND	165		8.18	ND	38.4	778
05/31/2016	ND	166		10	ND	38.4	475
06/30/2016	2.595	96		18.05	ND	33.6	531
06/30/2016	2.92	128	0.94	22.7	2.83	53.85	810
07/31/2016	3.37	187.5		14.3	ND	64.4	888
08/31/2016	3.27	220		2.42	2	38.4	585
09/30/2016	2.35	303	0.44	1.39	10	24.6	706
10/31/2016	10	300		5	2	15.5	595
11/30/2016	10	284		5	2	18.1	606
12/31/2016	2	248	8.32	1	10	36.2	881
01/31/2017	10	374		5	2	21.4	650

[10] Clinch River classification for Domestic Water Supply, detection limits per EPA Method 200.8 or 200.9.

02/28/2017	2	221		1	2	40.6	1420
03/31/2017	3.18	284	0.66	1.16	10	25.5	972
04/30/2017	10	221		5	10	30.9	663
05/31/2017	10	155		5	2	41.2	915
06/30/2017	2.52	290	0.26	1.21	44.4	36.8	1110

Accordingly, reporting of metals during Interim Limits is included at IMP 01A, however no numerical limits are established in the absence of reasonable potential for WQBELS or applicable ELGs for metals. Metals and related constituents are selected from Appendices III and IV of the CCR rules.

Monitoring of mercury is continued. FGD wastewater remains the only significant source of mercury in KIF wastewater following conversion to dry ash management. Numeric limits for TSS and O&G are applicable from ELGs for Combustion Residual Leachate as stated earlier.

PROPOSED INTERIM EFFLUENT LIMITS –IMP 01A.

INTERIM
Description : External Outfall, Number : 01A, Monitoring : Effluent Gross, Season : All Year

Code	Parameter	Qualifier	Value	Unit	Sample Type	Frequency	Statistical Base
00400	pH	>=	6.0	SU	Grab	Weekly	Minimum
00400	pH	<=	9.0	SU	Grab	Weekly	Maximum
00530	Total Suspended Solids (TSS)	<=	100	mg/L	Grab	Monthly	Daily Maximum
00556	Oil & Grease	<=	20	mg/L	Grab	Monthly	Daily Maximum
71900	Mercury, total (as Hg)	Report	-	ng/L	Grab	Monthly	Daily Maximum
50050	Flow	Report	-	MGD	Instantaneous	Weekly	Monthly Average
50050	Flow	Report	-	MGD	Instantaneous	Weekly	Daily Maximum
	Boron	Report	-	ug/L	Instantaneous	Quarterly	Daily Maximum
	Calcium	Report	-	ug/L	Instantaneous	Quarterly	Daily Maximum
	Chloride	Report	-	ug/L	Instantaneous	Quarterly	Daily Maximum
	Fluoride	Report	-	ug/L	Instantaneous	Quarterly	Daily Maximum
	Sulfate	Report	-	ug/L	Instantaneous	Quarterly	Daily Maximum
	Total Dissolved Solids	Report	-	ug/L	Instantaneous	Quarterly	Daily Maximum
	Antimony	Report	-	ug/L	Instantaneous	Quarterly	Daily Maximum
	Arsenic	Report	-	ug/L	Instantaneous	Quarterly	Daily Maximum
	Barium	Report	-	ug/L	Instantaneous	Quarterly	Daily Maximum
	Beryllium	Report	-	ug/L	Instantaneous	Quarterly	Daily Maximum
	Cadmium	Report	-	ug/L	Instantaneous	Quarterly	Daily Maximum
	Chromium	Report	-	ug/L	Instantaneous	Quarterly	Daily Maximum
	Cobalt	Report	-	ug/L	Instantaneous	Quarterly	Daily Maximum
	Lead	Report	-	ug/L	Instantaneous	Quarterly	Daily Maximum
	Lithium	Report	-	ug/L	Instantaneous	Quarterly	Daily Maximum

	Molybdenum	Report	-	ug/L	Instantaneous	Quarterly	Daily Maximum
	Selenium	Report	-	ug/L	Instantaneous	Quarterly	Daily Maximum
	Thallium	Report	-	ug/L	Instantaneous	Quarterly	Daily Maximum
	Radium226 and 228 combined	Report	-	ug/L	Instantaneous	Quarterly	Daily Maximum

FINAL LIMITS – FGD Wastewater at Internal Monitoring Point 009:

Final Permit Limits for FGD wastewater (i.e., ELGs) are applied at IMP 009. IMP 009 is established as the point of compliance for treated FGD wastewater ELGS prior to mixing with the discharge from the FGD landfill process water pond, designated IMP 01A. The limits are applicable following construction/startup of new wastewater treatment and division approval of the initial operating period. Monthly reporting is established for these parameters.

Description : Internal Monitoring Point, Number : Outfall 009, Monitoring : Effluent Gross, Season : All Year

Code	Parameter	Qualifier	Value	Unit	Sample Type	Frequency	Statistical Base
00400	pH	>=	6.0	SU	Grab	Monthly	Minimum
00400	pH	<=	9.0	SU	Grab	Monthly	Maximum
00530	Total Suspended Solids (TSS)	<=	100	mg/L	Grab	Monthly	Daily Maximum
00556	Oil & Grease	<=	20	mg/L	Grab	Monthly	Daily Maximum
01002	Arsenic, total (as As)	<=	11.0	ug/L	Grab	Monthly	Daily Maximum
01002	Arsenic, total (as As)	<=	8.0	ug/L	Grab	Monthly	Monthly Average
01027	Mercury, total (as Hg)	<=	788	ng/L	Grab	Monthly	Daily Maximum
01027	Mercury, total (as Hg)	<=	356	ng/L	Grab	Monthly	Monthly Average
01092	Nitrite plus Nitrate, total (as N)	<=	17.0	mg/L	Grab	Monthly	Daily Maximum
01092	Nitrite plus Nitrate, total (as N)	<=	4.4	mg/L	Grab	Monthly	Monthly Average
01147	Selenium, total (as Se)	<=	23.0	ug/L	Grab	Monthly	Monthly Average
01147	Selenium, total (as Se)	<=	12.0	ug/L	Grab	Monthly	Daily Maximum
50050	Flow	Report	-	MGD	Continuous	Monthly	Monthly Average
50050	Flow	Report	-	MGD	Continuous	Monthly	Daily Maximum

F. OUTFALL 01B – EMERGENCY OVERFLOW - - POND AT FGD DEWATERING/LANDFILL WASTEWATER

In circumstances resulting from a probable maximum precipitation event, TVA will collect and maintain records on the duration of the event, the amount of precipitation affecting the overflow, and results of an inspection of the pond for structural stability in accordance with Part III of the permit.

G. IMP 005 - METAL CLEANING WASTEWATER

PROPOSED EFFLUENT LIMITS – IMP 005
For Chemical Cleaning Wastes (non-hazardous portion)

Description : Internal Outfall, Number :IMP 005, Monitoring : Effluent Gross, Season : All Year

Code	Parameter	Qualifier	Value	Unit	Sample Type	Frequency	Statistical Base
00400	pH	>=	6.0	SU	Grab	Weekly	Minimum
00400	pH	<=	9.0	SU	Grab	Weekly	Maximum
00530	Total Suspended Solids (TSS)	Report	-	mg/L	Grab	Weekly	Daily Maximum
00556	Oil & Grease	Report	-	mg/L	Grab	Weekly	Daily Maximum
01042	Copper	<=	1.0	mg/L	Grab	Monthly	Daily Maximum
01045	Iron	<=	1.0	mg/L	Grab	Monthly	Daily Maximum

For **Non-**Chemical Cleaning Wastes

Description : Internal Outfall, Number :IMP 005, Monitoring : Effluent Gross, Season : All Year

Code	Parameter	Qualifier	Value	Unit	Sample Type	Frequency	Statistical Base
00400	pH	>=	6.0	SU	Grab	Weekly	Minimum
00400	pH	<=	9.0	SU	Grab	Weekly	Maximum
00530	Total Suspended Solids (TSS)	Report	-	mg/L	Grab	Weekly	Daily Maximum
00556	Oil & Grease	Report	-	mg/L	Grab	Weekly	Daily Maximum

H. SEEPS

1. Overview

Under revised EPA ELGs for the Steam Electric Power sector under 40 CFR Part 423, seeps are defined as Combustion Residual Leachate:

The term combustion residual leachate means leachate from landfills or surface impoundments containing combustion residuals. Leachate is composed of liquid, including any suspended or dissolved constituents in the liquid, that has percolated through waste or other materials emplaced in a landfill, or that passes through the surface impoundment's containment structure (e.g., bottom, dikes, berms). Combustion residual leachate includes seepage and/or leakage from a combustion residual landfill or impoundment unit.

2. Existing Seeps

In the KIF permit renewal application, TVA identified 3 seeps:

- Seep 1 at the FGD stormwater pond (CCR landfill) near the Watts Bar Lake shoreline;
- Seep 2 at the East Kike near the Intake Channel (inactive CCR landfill) approx. 600 feet east thereof;
- Seep 3 at the former Stilling Pond (former CCR impoundment) on the Emory River shoreline near the intake skimmer wall (no longer contains liquids). Current status of this seep is not available at this writing.

Under normal plant and reservoir operating conditions, any flow from Seeps 2 and 3 that would reach surface waters would discharge through Outfall 002, along with flow from Outfall 001.

[Note: The former red water seep, labelled Outfall 007 in the previous permit, has been redirected to the polishing pond/stilling pond influent channel.]

Seeps 1 and 3 are located in the portion of the FGD and Stilling Pond dikes which have been stabilized as part of dike structural integrity requirements undertaken following the Kingston Recovery Project. At Seep 2, a stability project is underway and, at this writing, is under review of design for construction in late 2017.

TVA describes these seeps as follows:

The flow rate of seepage from ash management unit embankments is generally so low that it is not measurable and, in any event, is significantly less than the permitted discharge from Outfall 001 of 14.03 million gallons per day as a long term average. Generally, seepage percolates through the embankment, is diffuse in nature, and is a nonpoint source from the ground surface lacking a discernible, confined, and discrete conveyance. Any additional pollutant loading from seeps would be de minimis and is expected to have an insignificant impact on surface water quality.

Since it is not feasible to measure potential seep-related impacts in surface waters in the reservoir due to the diffuse nature of seepage and the large volume of mixing, aquatic community assessments provide information on potential impacts. TVA has compiled aquatic and benthic community data upstream and downstream of the plant in 10 studies from 2001- 2015. These data demonstrate that seepage has not affected the maintenance of a balanced, indigenous population of aquatic life in the vicinity of the plant. Such monitoring will continue for the duration of the permit[11]*.*

3. Reasonable Potential Analysis

Using the methodology to assess the potential for seeps to cause exceedances of water quality criteria (see procedures in Appendix 2), the following assumptions are made:

- The mixing zone for Seeps 2 and 3 coincides with that of Outfall 001, so these flows are mixed with the minimum stream flow through the intake channel.
  - Flow from Outfall 001 from application = 14 MGD.
  - Flow from Seeps 2 and 3 are assumed at 3 gpm each, based on the 2015 Annual Seep Inspection Report, with daily flow = 2 x 1440 ÷ 10^{-6} ~ 0.03 MGD
  - Total Wastewater Flow = 14.03 MGD
- Minimum stream flow is based on the minimum operating conditions for the 9 generating units at this facility:
  - operation of 1 unit running full open at 187 MGD, 2 similar units (187 MGD each) being operated at 50% of capacity, 4 of the smaller units (140 MGD each) being operated at 50% of capacity, and 2 smaller units (140 MGD each) being held in reserve.
  - Minimum flow = (187 MGD) + 0.5 x (187 MGD x 2) + 0.5 x (140 MGD x 4) = 654 MGD

[11] TVA letter (Cheek) to DWR (Janjic), Subj: TVA-KIF TN0005452 and TN0080870 *Supplemental Information for Application, 26 October 2016.*

- Stream background concentrations are from plant intake data shown on application Form 2C for Outfall 002, pp. V-1 to V-4.

Findings:

Calculations shown on following page indicate that seep discharges plus Outfall 001 are **not likely to cause exceedances of TN water quality criteria**, nor are numeric metals limits warranted, based on WQ conditions.

WATER QUALITY BASED EFFLUENT CALCULATIONS
SEEPS 2 AND 3 + OUTFALL 001

Hardness data: 130 mg/l
Clinch RM 4.5
TDEC Ambient Sta.

Stream (1Q10)	Stream (30Q5)	Waste Flow	Ttl. Susp. Solids	Hardness as CaCO3	Stream Allocation
[MGD]	[MGD]	[MGD]	[mg/l]	[mg/l]	[%]
654.0	654.0	14.03	9	130	90

	1	2	3	4	5	6	7	8
	Stream	Fish/Aqua. Life		Effluent	Fish & Aquatic Life WQ Criteria (1Q10)			
	Bckgrnd.	WQ Criteria		Fraction	In-Stream Allowable		Calc. Effluent Conc'n	
EFFLUENT	Conc.***	Chronic	Acute	Dissolved	Chronic	Acute	Chronic	Acute
CHARACTERISTIC	[ug/l]	[ug/l]	[ug/l]	[Fraction]	[ug/l]	[ug/l]	[ug/l]	[ug/l]
Aluminum	155	--	--		--	--	--	--
Antimony	2	--	--		--	--	--	--
Arsenic	2	150	340		150	340	**6344**	**14486**
Barium	39	--	--		--	--	--	--
Beryllium	1	--	--		--	--	--	--
Boron	102	--	--		--	--	--	--
Cadmium *	1	0.295	2.59	0.194	1.52	13.36	**23**	**530**
Calcium		--	--		--	--	--	--
Chromium *	0.5	706.3	33.8	0.084	8392	401	**359613**	**17168**
Cobalt	2	--	--		--	--	--	--
Copper *	0.2	11.21	17.21	0.220	51.0	78.3	**2177**	**3347**
Iron	179	--	--		--	--	--	--
Lead *	0.2	3.34	85.83	0.152	21.98	564	**934**	**24163**
Magnesium	11	--	--		--	--	--	--
Manganese	35	50	100	1.0	50.00	100	**674**	**2817**
Mercury, (T) **	0.004	0.770	1.4		0.77	1.40	**33**	**60**
Molybdenum	50	--	--		--	--	--	--
Nickel *	2	64.9	584.6	0.210	309	2784	**13169**	**119233**
Selenium	2.0	5	20	1.0	5	20	**130**	**773**
Silver *	0.5	--	5.051	1.0	--	5.05	--	**195**
Sodium		--	--		--	--	--	--
Thallium	2	--	--		--	--	--	--
Tin	50	--	--		--	--	--	--
Titanium	50	--	--		--	--	--	--
Vanadium		--	--		--	--	--	--
Yttrium		--	--		--	--	--	--
Zinc *	10	146.35	146.35	0.13	1136.38	1136.38	**48278**	**48278**
Cyanide (T) **	7.0	5.2	22.0	1.0	5.2	22.0	**-71**	**649**

	9	10	11	12	13	14	
	Human Health Water Quality Criteria (30Q5)						Outfall
	In-Stream Criteria			Calc. Effluent Concentration			001
EFFLUENT	Organisms	ater/Organis	DWS	Organisms	ater/Organis	DWS	Conc'n
CHARACTERISTIC	[ug/l]	[ug/l]	[ug/l]	[ug/l]	[ug/l]	[ug/l]	ug/l
Aluminum	--	--	--	--	--	--	895
Antimony	5.6	5.6	6.0	**156**	**156**	**173**	4.8
Arsenic	10.0	10.0	10.0	**345**	**345**	**345**	56
Barium	--	--	2000	--	--	**84070**	415
Beryllium	--	--	4.0	--	--	**129**	1.0
Boron	--	--	--	--	--	--	375
Cadmium *	--	--	5.0	--	--	**172**	0.30
Calcium	--	--	--	--	--	--	
Chromium III *	--	--	100.0	--	--	**4264**	9.50
Cobalt	--	--	--	--	--	--	5.5
Copper *	--	--	--	--	--	--	1.8
Iron	--	--	--	--	--	--	200
Lead *	--	--	5.0	--	--	**206**	2
Magnesium	--	--	--	--	--	--	12000
Manganese	--	50	100	--	**674.3**	**2817**	25.0
Mercury, (T) **	0.051	0.050	2.0	**2.0**	**2.0**	**86**	0.15
Molybdenum	--	--	--	--	--	--	65
Nickel *	4600	610	100	**197040**	**26056**	**4201**	4
Selenium	--	--	50.0	--	--	**2059**	16
Silver *	--	--	--	--	--	--	0.30
Sodium	--	--	--	--	--	--	
Thallium	0.47	0.24	2.0	**-63.8**	**-73.6**	**2**	1.5
Tin	--	--	--	--	--	--	46.0
Titanium	--	--	--	--	--	--	27.5
Vanadium	--	--	--	--	--	--	
Yttrium	--	--	--	--	--	--	
Zinc *	--	--	--	--	--	--	16.0
Cyanide (T) **	140.0	140.0	200.0	**5706**	**5706**	**NA**	NA

NA = not applicable.

* Denotes metals for which Fish & Aquatic Life Criteria are expressed as a function of total hardness.The Fish & Aquatic Life criteria for this metal are in the dissolved form at laboratory conditions. The in-stream allowable criteria and calculated effluent concentrations are in the total recoverable form.

** Chronic criterion for mercury is not converted to dissolved, as it addresses bioaccumulation rather than toxicity.

*** Stream background concentrations are taken from intake sample on 2016 permit application;
except for manganese, which is upstream TDEC ambient data at RM 10.0, since app'n data considered outlier.
[reported detection levels are used when no reportable concentration exists.]

4. Permitting Approach

i. Effluent Limitations Guidelines for Combustion Residual Leachate

As noted above, the term *combustion residual leachate* means leachate from landfill or surface impoundments containing combustion residuals. At KIF, the ELGs apply to seeps from any inactive ash landfills, such as the collection system for the East Dike Seepage project being treated at Outfall 001, and from the leachate collection system at the FGD landfill being treated and discharged at IMP 01A.

ELGs are defined under CCR Leachate provisions below:

40 CFR 423.12 (11) The quantity of pollutants discharged in FGD wastewater, flue gas mercury control wastewater, **combustion residual leachate**, or gasification wastewater shall not exceed the quantity determined by multiplying the flow of the applicable wastewater times the concentration listed in the following table:

Pollutant or pollutant property	BPT Effluent limitations	
	Maximum for any 1 day (mg/l)	**Average of daily values for 30 consecutive days shall not exceed (mg/l)**
TSS	100.0	30.0
Oil and grease	20.0	15.0

The BAT requirement mirrors BPT and the technology basis for CCR leachate is treatment by impoundment. The TSS and O&G limits are shown in the proposed permit limits for Outfall 001 and 01A above.

ii. No Existing Wastewater Impoundments Classed as Dams

In previous permits, TDEC addressed seeps from ash pond dikes by requiring weekly dam safety-related dike inspections for structural integrity.

With the closure of existing wastewater impoundments having earthen dikes, and construction of the new Process Water Ponds at Outfall 001, there are no wastewater impoundments that warrant dam safety considerations. Neither of the two Process Water Ponds (one at Outfall 001, and one at IMP 01A - FGD dewatering and landfill area) are considered as dams. Both impoundments are not defined as CCR impoundments and are constructed with liners such that seepage through earthen dikes has been minimized or eliminated. Inspections of the existing wastewater impoundments will be performed under the Permit's Part I requirements at Rule 0400-40-05-.07(2)© for proper operation and maintenance:

> *The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit..*

iii. Seep Action Plan

In this renewed permit, TVA shall submit a Seep Action Plan describing inspection of the plant property containing inactive ash disposal areas and response to any findings of seeps. The Plan will be submitted for Division approval within 90 days of the permit effective date.

iv. Content of Seep Action Plan

TDEC expects the Plan will address the following, as a minimum:

- Inspection requirements of former ash disposal areas to identify seeps;
- Measures for expedited repairs of seeps upon discovery;
- Submission of an annual report of results of seep inspections, a listing of seep conditions, and remedial actions completed and in progress;
- Submission of the annual report by July 1 of each year.
- A protocol for assessing existing and/or newly identified seeps as to the potential for discharge to surface waters, methods used in assessing potential effects on surface waters, and duration and frequency (at least a quarterly) of the assessment methods.
- Design, and engineering and various construction approaches planned for use in repairing a range of seeps, to include collection and routing the seep's flow to an existing treatment system/permitted outfall.
- A procedure whereby TVA will notify TDEC of proposed discharge worthy of requesting a modification to the NPDES permit for an additional permitted outfall.
- To ensure structural stability is maintained at repaired seeps, continued dike inspection procedures which are equivalent to Section I below.

I. DIKE INSPECTIONS AT REPAIRED SEEPS FOR FORMER ASH DISPOSAL AREAS

1. Dike inspection requirements on a weekly basis to assess the current condition of repaired seep(s).
2. The permittee must repair seeps in a manner that protects the structural integrity of the former disposal area, and either:

    a. Eliminate any discharge to surface waters from the seep, or,
    b. Reroute any flow back to an approved treatment unit for discharge to surface waters through a permitted outfall, or
    c. Repair the seep in a manner that protects the structural integrity of the former disposal area while allowing flow from the seep to continue. In this case, the permittee must:
        1. Notify the Department and receive approval for this repair; and,
        2. Repair the seep and collect all flow through the seep and return the wastewater to the wastewater treatment unit, or
        3. Demonstrate to the Department that the continued flow through the seep after the repair meets published TN water quality criteria, (and continues to meet WQC from assessments conducted at least quarterly) or,
        4. Request a modification to the NPDES permit for an additional permitted outfall comprised of the continued flow from the seep.

G. DIKE INSPECTIONS FOR WASTEWATER IMPOUNDMENTS

Dike inspection requirements for wastewater impoundments are not retained in the renewed permit. These requirements were previously included to assess the structural stability of ash impoundments, in accordance with TVA's Reservoir Operations Dam Safety Program.

Following dewatering and closure of the Stilling Pond, the only wastewater basins that remain at KIF are the two Process Water Ponds – one at Outfall 001 and one at IMP 01A serving the Gypsum processing and dewatering facility on the peninsula.

Depth of water in these ponds is approximately 4-5 feet, and, thus Dam Safety inspection provisions for structural stability are not applicable.[12] The conduct of routine dike inspections of these ponds will fall under permit requirements of proper operation and maintenance for wastewater treatment facilities (Rule 0400-40-05.07(2)), and is not a separate narrative requirement in the permit renewal.

H. COMPLIANCE WITH CWA SECTION 316

1. Section 316a Thermal Variance for Outfall 002

Outfall 002 is subject to compliance with certain Tennessee Water Quality Standards (the "TN Standards") for temperature. Section 0400-40-.03 of the TN Standards provides that heated water discharges shall not cause the maximum receiving water temperature to exceed 3°C relative to an upstream control point nor to exceed 30.5°C. This section also provides that the maximum rate of water temperature change shall not exceed 2°C per hour. .

Section 316(a) of the Clean Water Act (the "Act") allows the permitting authority to impose alternative and less stringent thermal limitations after demonstration that the water quality standards limitations are more stringent than necessary to ensure the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in and on the receiving water. In addition, Section 316(b) of the Act requires that the location, design, construction, and capacity of a cooling water intake structure reflect the best technology available for minimizing environmental impacts.

In previous NPDES permits, TVA has provided information to support its request that a daily maximum condenser cooling water discharge temperature limitation of 36.1°C (97°F) be allowed under Section 316(a) of the Act. Since EPA issued it in 1976, NPDES permits have allowed alternative limitations on the thermal component of the facilities' condenser cooling water discharge and required that data be presented that ensures protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in and on the Watts Bar Reservoir of the Tennessee, Clinch, and Emory Rivers.

TVA submitted biological monitoring data from Fall, 2015 as part of the application for NPDES permit renewal[13]. This report is available for viewing online at the DWR Permits Dataviewer http://environment-online.tn.gov:8080/pls/enf_reports/f?p=9034:34001.

Biological monitoring data for the sites upstream and downstream of KIF were similar and within the acceptable range of variation such that these data met requirements of a balanced indigenous population. Based on the above factors and information, a determination has been made that continuation of the 316(a) variance, with an alternative thermal limit of 36.1 °C is appropriate in the reissuance of this permit.

[12] TN Safe Dams Rule 0400-45-07: impoundments of less than six (6) feet in depth of storage capacity of less than 15 acre-feet shall not be considered a dam.

[13] TVA, *Biological Monitoring of the Clinch River Near Kingston Fossil Plant Discharge, Autumn 2015,* prepared by TVA River and Reservoir Compliance Monitoring, May 2016.

2. Section 316b - Cooling Water Intake Structure

a) Background

The section 316(b) Existing Facility Final Rule applies to the TVA-KIF cooling water intake structure which withdraws water from the Emory and Clinch Rivers. Since the facility meets the conditions specified below (from 40 CFR 125.91), it is subject to the rule.

The rule applies to owners and operators of existing facilities that meet all of the following criteria:

- The facility is a point source;
- The facility uses or proposes to use one or more cooling water intake structures with a cumulative design intake flow (DIF) of greater than 2 mgd to withdraw water from waters of Tennessee; and,
- Twenty-five percent or more of the water the facility withdraws on an actual intake flow basis is used exclusively for cooling purposes.

Generally, facilities that meet these criteria fall into two major groups: steam electric generating facilities and manufacturing facilities. The rule establishes national requirements applicable to the location, design, construction, and capacity of cooling water intake structures at existing facilities that reflect the best technology available for minimizing the adverse environmental impact - impingement and entrainment – associated with the use of these structures. The rule requires several types of information collection as part of the NPDES permit application. ln general, the information would be used to identify both how the facility plans to meet the rule requirements and if the facility is already meeting the rule requirements.

b) Specific data requirements with next permit application

Per 40 CFR 125.95(a)(2), the renewed permit establishes the following specific data requirements. Submission dates are discussed below.

- **Source water physical data** which shows the physical configuration of all source waterbodies used by the facility, identifies and characterizes the source waterbody's hydrological and geomorphological features, and provides location through maps §122.21(r) (2).

- **Cooling water intake structure data** which shows the configuration and location of cooling water intake structures, provides details on the design and operation of each cooling water intake structure, and diagrams showing flow distribution and water balance § 122.21(r)(3)1.

- **Source water baseline biological characterization data** that characterizes the biological community in the vicinity of the cooling water intake structure (CWIS) and characterizes the operation of the CWIS § 122.21(r)(4)1.

- **Cooling water system data** that, among other things, describes the operation of the cooling water system, its relationship to the CWIS, the proportion of the design intake flow used in the system, the number of days the cooling water system is operational and seasonal changes in operation, as well as design and engineering calculations to support these descriptions § 122.21(r)(5).

- Information that describes the facility's chosen m**ethod of compliance with impingement mortality standards**; the specific requirements vary, depending on the compliance approach chosen by the facility. This information would be reflected in the facility's Impingement Technology Performance Optimization Study § 122.21 (r)(6).

- Description of any existing **entrainment performance studies** of biological survival conducted at the facility and a summary of any conclusions or results §122.21(r)(7).

- **Operational status** data that describes the operational status of each generating, production, or process unit §122.21(r)(8).

- An **entrainment characterization study** including data collection method, biological entrainment characterization, and analysis and supporting documentation per § 122.21 (r)(9) that has been peer reviewed per § 122.21 (r)(13).

- **Comprehensive Technical Feasibility and Cost Evaluation Study** of technical feasibility of closed-cycle cooling, fine mesh screens, and water reuse or alternate sources of cooling water; evaluation of entrainment control technologies; and cost evaluations per § 122.21 (r)(10).

- **Benefits Valuation Study** of candidate technologies and operations measures, basis for monetized values and discussion of mitigation per § 122.21 (r)(11).

- **Non-WQ Environmental and Other Impacts Study** addressing energy consumption, emissions levels, water consumptions, etc. per § 122.21 (r)(12).

c) Submission Dates

Based on the number and complexity of the studies, reports, and peer reviews to be conducted and the time needed to complete such efforts, this renewed permit establishes an alternate schedule for submittal of information specified in § 122.21 (r)(2) through § 122.21 (r)(13) no later than 180 days prior to the expiration date. Accordingly, the permit duration will include the full five year term to enable sufficient time to complete these requirements.

d) Best Professional Judgment analysis

Since November 10, 1977[14], a determination was also made in accordance with Section 316(b) of the Act that the location, design, construction, and capacity of the facility's cooling water intake structure reflects the best technology available for minimizing adverse environmental impacts. That determination was based on the results of impingement and entrainment studies conducted by TVA during 1974 and 1975, and in subsequent permit rationale's prepared by the State of TN, the biological data has maintained that conclusion.

Based on information provided in the 2016 permit application and 40 CFR 125.98(b)(2)(ii)(6), the Division has determined that TVA-KIF condenser cooling water intake structure continues to reflect the best technology available, and no required changes to the intake are proposed at this time.

IX. ELECTRONIC REPORTING

EPA published the National Pollutant Discharge Elimination System (NPDES) Electronic Reporting Rule, which modernized Clean Water Act reporting for municipalities, industries and other facilities. The rule was published in the Federal Register on October 22, 2015 and became effective on December 22, 2015. The rule replaced most paper-based NPDES reporting requirements with electronic reporting.

[14] EPAR4 issued TVA fossil permits until TN was delegated authority to permit federal facilities in September 1986.

Since 2016, TVA-KIF has been submitting Discharge Monitoring Reports (DMRs) electronically through NetDMR.

X. ANTIDEGRADATION

Tennessee's Antidegradation Statement is found in the Rules of the Tennessee Department of Environment and Conservation, Chapter 0400-40-03-.06. It is the purpose of Tennessee's standards to fully protect existing uses of all surface waters as established under the Act.

Stream determinations for this permit action are associated with the waterbody segment identified by the division as segment ID#:TN06010207001_0100. The division has assessed the Watts Bar Reservoir/Clinch River arm and found the receiving stream to be neither an exceptional nor outstanding national resource water.

Unavailable Conditions Waters (assessed as needing additional pollution controls)

Additionally, this portion of the Clinch River does not fully support designated recreational uses due to elevated concentrations in fish tissue of PCBs, mercury, and chlordane. Elevated levels of mercury in fish tissue have been historically related to upstream discharges from USDOE facilities on the Oak Ridge Reservation. TVA discharges of mercury in FGD wastewaters are discussed above. However, effects on fish tissue from these dual sources has not been specifically defined.

TVA discharges do not contain PCBs or chlordane; these pollutants also originate from upstream sources. The division, therefore, considers the potential for degradation to the receiving stream from permitted discharges to be negligible.

TMDLs have been developed and approved for the Lower Clinch watershed on the following parameters and dates:

Parameter	TMDL Approval Date
Pathogens	11/29/2005
Siltation and habitat alteration	03/29/2006
PCBs	03/18/2010
Melton Hill Reservoir - TMDL for chlordane and PCBs	08/09/2010

The proposed terms and conditions of this permit comply with the wasteload allocations of these TMDLs.

XI. PERMIT DURATION

This permit expires in five years from the effective date. This time period is authorized to enable the permittee to compile required data and prepare required 122r reports and to complete projects required to attain compliance with ELGs identified in the Schedule of Compliance.

APPENDIX 1 - PROCEDURES FOR WATER-QUALITY-BASED LIMITS USING REASONABLE POTENTIAL CALCULATIONS (Feb. 2017)

The following procedure is used to calculate the allowable instream concentrations for permit limitations.

a. The most recent background conditions of the receiving stream segment are compiled. This information includes:

   * 1Q10 of receiving stream (654 MGD)
   * Calcium hardness (25 mg/l, default)
   * Total suspended solids (10 mg/l, default)
   * Background metals concentrations (from plant intake data)

b. The chronic water quality criteria are converted from total recoverable metal at lab conditions to dissolved lab conditions for the following metals: cadmium, copper, trivalent chromium, lead, nickel and zinc. Then translators are used to convert the dissolved lab conditions to total recoverable metal at ambient conditions.

c. The acute water quality criteria are converted from total recoverable metal at lab conditions to dissolved lab conditions for the following metals: cadmium, copper, trivalent chromium, lead, nickel, zinc and silver. Then translators are used to convert the dissolved lab conditions to total recoverable metal at ambient conditions for the following metals: cadmium, copper, lead, nickel and silver.

d. The resulting allowable trivalent and hexavalent chromium concentrations are compared with the effluent values characterized as total chromium on permit applications. If reported total chromium exceeds an allowable trivalent or hexavalent chromium value, then the calculated value will be applied in the permit for that form of chromium unless additional effluent characterization is received to demonstrate reasonable potential does not exist to violate the applicable state water quality criteria for chromium.

e. A standard mass balance equation determines the total allowable concentration (permit limit) for each pollutant. This equation also includes a percent stream allocation of no more than 90%.

   The following formulas are used to evaluate water quality protection:

$$Cm = \frac{QsCs + QwCw}{Qs + Qw}$$

where:

Cm = resulting in-stream concentration after mixing
Cw = concentration of pollutant in wastewater
Cs = stream background concentration
Qw = wastewater flow
Qs = stream low flow

to protect water quality:

$$Cw \leq \frac{(S_A)\,[Cm\,(Qs + Qw) - QsCs]}{Qw}$$

where (S_A) is the percent “Stream Allocation”.

Calculations for this permit have been done using a standardized spreadsheet, titled "Water Quality Based Effluent Calculations." Division policy dictates the following procedures in establishing these permit limits:

1. The critical low flow values are determined using TVA data from River Operations. Because the low flow values involve regulated flow conditions, the minimum flow value on a 1Q10 basis is used to calculate both Fish and Aquatic Life Protection and Recreation compliance.

2. Fish & Aquatic Life water quality criteria for certain Metals are developed through application of hardness dependent equations. These criteria are combined with dissolved fraction methodologies in order to formulate the final effluent concentrations.

3. For criteria that are hardness dependent, chronic and acute concentrations are based on a Hardness value from plant intake data and Total Suspended Solids (TSS) of 10 mg/L. The minimum limit on the TSS value used for water quality calculations is 10 mg/L.

4. Background concentrations are determined from TVA measurements of raw water quality taken at the fossil plant intake. If the measured background concentration is greater than the chronic “In-stream Allowable” water quality criteria, then the measured background concentration is used in lieu of the chronic “In-stream Allowable” water quality criteria for the purpose of calculating the appropriate effluent limitation (Cw). Under these circumstances, and in the event the “stream allocation” is less than 100%, the calculated chronic effluent limitation for fish and aquatic life should be equal to the chronic “In-stream Allowable” water quality criteria. Where the industrial source water is the receiving stream, and the measured background concentration is greater than the chronic “In-stream Allowable” water quality criteria, consideration may be given as to the degree to which the permittee should be required to meet the requirements of the water quality criteria in view of the nature and characteristics of the receiving stream.

The spreadsheet has fifteen (15) data columns, all of which may not be applicable to any particular characteristic constituent of the discharge. A description of each column is as follows:

Column 1: The "Stream Background" concentrations of pollutants found in the effluent.

Column 2: The "Chronic" Fish and Aquatic Life Water Quality criteria. For cadmium, copper, trivalent chromium, lead, nickel, and zinc, this value represents the criteria for the dissolved form at laboratory conditions. The Criteria Continuous Concentration (CCC) is calculated using the equation:

$$CCC = (\exp\{ m_C [\ln(\text{stream hardness})] + b_C \}) (CCF)$$

CCF = Chronic Conversion Factor

This equation and the appropriate coefficients for each metal are from Tennessee Rule 0400-40-03-.03 and the EPA guidance contained *in The Metals Translator: Guidance For Calculating A Total Recoverable Permit Limit From a Dissolved Criterion* (EPA 823-B-96-007, June 1996). Values for other metals are in the total form and are not hardness dependent; no chronic criterion exists for silver. Published criteria are used for non-metal parameters.

Column 3: The "Acute" Fish and Aquatic Life Water Quality criteria. For cadmium, copper, trivalent chromium, lead, nickel, silver, and zinc, this value represents the criteria for the dissolved form at laboratory conditions. The Criteria Maximum Concentration (CMC) is calculated using the equation:

$$CMC = (\exp \{ m_A [\ln (\text{stream hardness})] + b_A \}) (ACF)$$

ACF = Acute Conversion Factor

This equation and the appropriate coefficients for each metal are from Tennessee Rule 0400-40-03-.03 and the EPA guidance contained in *The Metals Translator: Guidance For Calculating A Total Recoverable Permit Limit From a Dissolved Criterion* (EPA 823-B-96-007, June 1996). Values for other metals are in the total form and are not hardness dependent. Published criteria are used for non-metal parameters.

Column 4: The “Fraction Dissolved” converts the value for dissolved metal at laboratory conditions (columns 2 & 3) to total recoverable metal at in-stream ambient conditions (columns 5 & 6). This factor is calculated using the linear partition coefficients found in *The Metals Translator: Guidance For Calculating A Total Recoverable Permit Limit From a Dissolved Criterion* (EPA 823-B-96-007, June 1996) and the equation:

$$\frac{C_{diss}}{C_{total}} = \frac{1}{1 + \{ [K_{po}] [ss^{(1+a)}] [10^{-6}] \}}$$

ss = in-stream suspended solids concentration [mg/l]

Linear partition coefficients for streams are used for unregulated (7Q10) receiving waters, and linear partition coefficients for lakes are used for regulated (1Q10) receiving waters. For those parameters not in the dissolved form in columns 2 & 3 (and all non-metal parameters), a Translator of 1 is used.

Column 5: The "Chronic" Fish and Aquatic Life Water Quality criteria at in-stream ambient conditions. This criteria is calculated by dividing the value in column 2 by the value in column 4.

Column 6: The "Acute" Fish and Aquatic Life Water Quality criteria at in-stream ambient conditions. This criteria is calculated by dividing the value in column 3 by the value in column 4.

Column 7: The "Chronic" Calculated Effluent Concentration for the protection of fish and aquatic life. This is the chronic limit.

Column 8: The "Acute" Calculated Effluent Concentration for the protection of fish and aquatic life. This is the acute limit.

Column 9: The In-Stream Water Quality criteria for the protection of Human Health associated with the stream use classification of Organism Consumption (Recreation).

Column 10: The In-Stream Water Quality criteria for the protection of Human Health associated with the stream use classification of Water and Organism Consumption. These criteria are only to be applied when the stream use classification for the receiving stream includes both “Recreation” and “Domestic Water Supply.”

Column 11: The In-Stream Water Quality criteria for the protection of Human Health associated with the stream use classification of Domestic Water Supply.

Column 12: The Calculated Effluent Concentration associated with Organism Consumption.

Column 13: The Calculated Effluent Concentration associated with Water and Organism Consumption.

Column 14: The Calculated Effluent Concentration associated with Domestic Water Supply.

The calculated chronic water quality effluent concentrations from Column 7 should be compared, individually, to the values calculated in Columns 12, 13, and 14 in order to determine the most stringent chronic permit limitations. The calculated acute water quality effluent concentrations from Column 8 should then be compared, individually, to values equal to two (2) times the values presented in Columns 12, 13, and 14 in order to determine the most stringent acute permit limitations. These water quality based limits should then be compared to any technology based (CFR or Tennessee "Rules") effluent limitations, and/or any previous permit limitations, for final determination of the permit limits.

APPENDIX 2 - PREVIOUS PERMIT LIMITS AND MONITORING REQUIREMENTS

PERMIT LIMITS

OUTFALL 001

EFFLUENT CHARACTERISTIC	EFFLUENT LIMITATIONS				MONITORING REQUIREMENTS	
	MONTHLY		DAILY			
	AVG. CONC. (mg/l)	AVG. AMNT. (lb/day)	MAX. CONC. (mg/l)	MAX. AMNT. (lb/day)	MSRMNT. FRQNCY.	SAMPLE TYPE
FLOW	Report (MGD) [1]		Report (MGD) [1]		1/Week	Instantaneous
pH [2]	--	--	Minimum of 6.0		1/Week	Grab
OIL & GREASE	14.4	--	19.4	--	1/Month	Grab
TOTAL SUSPENDED SOLIDS [3] (TSS)	29.9	--	92.0	--	1/Month	Grab
NITROGEN, AMMONIA TOTAL (at Skimmer Wall or comparable location)	--	--	Report	Report	2/Month	Grab
NITROGEN, AMMONIA TOTAL (Effluent)	--	--	Report	Report	2/Month	Grab
NITROGEN, AMMONIA TOTAL (Net Discharge)	--	--	Report [4]	Report [4]	2/Month	Calculated

1 Flow shall be reported in Million Gallons per Day (MGD).
2 pH analyses shall be performed within fifteen (15) minutes of sample collection.
3 The permittee shall take reasonable steps to prevent discharge of cenospheres other than in trace amounts from the outfall.
4 If a calculated value for net addition of ammonia as nitrogen exceeds an action concentration value of 2.85 mg/L, the permittee should investigate source(s) of ammonia, and proceed with a corrective action(s), if necessary. Furthermore, EAC -Knoxville shall be notified within 24 hours from the time the permittee receives results indicating that an action value of 2.85 mg/L was exceeded.

PERMIT LIMITS

OUTFALL 002

EFFLUENT CHARACTERISTIC	EFFLUENT LIMITATIONS				MONITORING REQUIREMENTS	
	MONTHLY		DAILY			
	AVG. CONC. (mg/l)	AVG. AMNT. (lb/day)	MAX. CONC. (mg/l)	MAX. AMNT. (lb/day)	MSRMNT. FRQNCY.	SAMPLE TYPE
FLOW	Report (MGD) [1]		Report (MGD) [1]		Daily	Pump logs
pH [2]	Range 6.0 to 9.0				1/Week	Grab
TEMPERATURE, Intake	--		Report		Continuous [3]	Recorder
TEMPERATURE, Effluent	--		36.1°C (97.0°F)		Daily	Calculate [3]
TOTAL RESIDUAL OXIDANT (reported as chlorine) [4]	0.038	--	0.066	--	1/Week	Grab [6]
TOTAL RESIDUAL OXIDANT (reported as chlorine) [5]	0.011	--	0.019	--	1/Week	Grab [6]
TIME OF OXIDANT ADDITION (minutes/day/unit)	--		120 [7]		1/Day	Log Records
IC25	Survival, Reproduction, & Growth in 100% Effluent				See note 8	Composite [8]

1 Flow shall be reported in Million Gallons per Day (MGD).
2 pH analyses shall be performed within fifteen (15) minutes of sample collection.
3 Intake temperature is measured hourly (continuously) but reported as a daily average once per day. The daily average discharge temperature shall be calculated for the cooling channel based on the 24-hour average intake temperature, 24-hour average unit load, and the 24-hour average flow through Outfall 002.
4 The limits depicted are applicable at flows of 654 MGD, and above, from Outfall 002. Only one (1) unit, with a flow rate of 187 MGD is allowed to be chlorinated at one time.
5 The limits depicted are applicable at flows less than 654 MGD, in lieu of the limits shown in footnote 4.
6 Flow weighted maximum shall be calculated from instantaneous measurements of the chlorinated discharges from a unit and adjusted for flow from the non-chlorinated units contributing to the discharge. The calculated flow-weighted maximum will be used for determination of compliance with the daily maximum limitation. Except for periods of macroinvertebrate control when oxidant addition is required (see Permit - Part III), samples shall be taken once at the beginning of the period of chlorination for one unit and once every 15 minutes thereafter. At the end of the period of chlorination for that unit, one sample shall be taken. Sampling for these oxidants is not required when there is no chlorine/bromine added during that day. TRC analyses shall be performed within fifteen (15) minutes of sample collection.
7 Application of a oxidant (bromine/chlorine) beyond the 120 minutes per day will be allowed to facilitate nuisance macroinvertebrate control according to the Plan for such activities described in Permit - Part III.
8 See Part III for sampling requirements and monitoring frequency of toxicity tests.

PERMIT LIMITS

INTERNAL MONITORING POINT 005
Nonchemical and Chemical Metal Cleaning Wastes

EFFLUENT CHARACTERISTIC	EFFLUENT LIMITATIONS				MONITORING REQUIREMENTS	
	MONTHLY		DAILY			
	AVG. CONC. (mg/l)	AVG. AMNT. (lb/day)	MAX. CONC. (mg/l)	MAX. AMNT. (lb/day)	MSRMNT. FRQNCY.	SAMPLE TYPE
FLOW	Report (MGD) *		Report (MGD) *		1/Batch	Estimate *
IRON, TOTAL	1.0	--	1.0	--	**	Grab
COPPER,TOTAL	1.0	--	1.0	--	**	Grab

Metal cleaning wastes shall mean any cleaning compounds, rinse waters, or any other waterborne residues derived from cleaning any metal process equipment including, but not limited to, boiler tube cleaning, boiler fireside cleaning, and air preheater cleaning.

* Flow shall be based on beginning and ending staff gage readings of the pond and reported in Million Gallons per Day (MGD).

** Samples shall be taken at the beginning and end of a discharge event for each batch treated.

Outfalls 006, 007, and 008 convey comparatively minor waste streams: storm water runoff, fire protection flushes, raw water leakage and noncontact cooling water from Outfall 006; storm water runoff and abandoned ash pond seepage from Outfall 007; drainage from sluice line trench from Outfall 008. All three outfalls are discharging into the facility's intake channel which ultimately discharges via Outfall 002. The combined flow from all three discharges is 0.588 MGD, which constitutes approximately 0.045% of the total flow used for cooling and other purposes at the facility. Consequently, there will be no numeric effluent limitations or specific monitoring requirements established for discharges from Outfalls 006, 007 and 008.

APPENDIX 3 – TVA Kingston ELG Applicability Date Proposal

Tennessee Valley Authority, 1101 Market Street, BR 4A, Chattanooga, Tennessee 37402-2801

October 2, 2017

Mr. Vojin Janjić
Division of Water Resources
Tennessee Department of Environment
and Conservation (TDEC)
William R. Snodgrass TN Tower
312 Rosa L. Parks Avenue, 11th Floor
Nashville, Tennessee 37243

Dear Mr. Janjić:

TENNESSEE VALLEY AUTHORITY (TVA) – KINGSTON FOSSIL PLANT (KIF) – NPDES PERMIT NO. TN0005452 – STEAM ELECTRIC EFFLUENT LIMITATION GUIDELINES (ELG) APPLICABILITY DATE PROPOSAL

Please find enclosed TVA's proposed schedule and information to support development of applicability dates under steam electric power generating point source category effluent limitation guidelines.

If you have questions or need additional information, please contact Brad Love at 423-751-8518 or by email at bmlove@tva.gov.

Sincerely,

Michael B. Skiffington

for: Terry E. Cheek
Senior Manager
Water Permits, Compliance, and Monitoring

Enclosure
cc: Tennessee Department of Environment
and Conservation
Knoxville Environmental Field Office
Attn: Mr. Michael Atchley
3711 Middlebrook Pike
Knoxville, Tennessee 37921

TN DEPT. OF ENV. & CONSERVATION

OCT 0 2 2017

DIVISION OF WATER RESOURCES

Tennessee Valley Authority (TVA) - Kingston Fossil Plant

Proposed Schedule and Information to Support Development of Applicability Dates under Steam Electric Power Generating Point Source Category Effluent Limitations Guidelines (ELGs)

EPA promulgated revised ELGs in 2015 for the steam electric power generating point source category.[1] The rule provides that the limits set for each wastestream will be applied to individual dischargers in the next NPDES permit issued after the rule's effective date of January 4, 2016. However, the specific applicability dates vary among different wastestreams:

- Limits on certain wastestreams, such as coal yard runoff, low volume wastes, and metal cleaning wastes, were unchanged in the revised ELGs and are currently applicable.
- Limits on combustion residual leachate will apply on the date of issuance of the next NPDES permit.[2]
- New, more stringent limits under the revised ELG requiring no discharge of fly ash transport waters will be applied to dischargers on a date to be set by the permitting authority that is as soon as possible beginning November 1, 2018, but no later than December 31, 2023.[3] The rule provides that discharges of this wastestream before the chosen applicability date should be subject to limitations based on the previously promulgated BPT limitations or the plant's other applicable permit limitations (e.g., any water quality-based effluent limitations) until at least November 1, 2018, or later if dictated by the selected applicability date.[4] In this interim time period until the selected applicability date, the rule also prescribes BAT limits on total suspended solids (TSS).[5]
- Due to a recent postponement rulemaking by EPA, new, more stringent limits under the revised ELG requiring no discharge of bottom ash transport waters (sometimes hereinafter, BATW), with few exceptions, will be applied to dischargers on a date to be set by the permitting authority that is as soon as possible beginning November 1, 2020, but no later than December 31, 2023.[6] The rule provides that discharges of this wastestream before the chosen applicability date should be subject to limitations based on the previously promulgated BPT limitations or the plant's other applicable permit limitations (e.g., any water quality-based effluent limitations) until at least November 1, 2020, or later if dictated by the selected applicability date.[7] In this interim time period until the selected applicability date, the rule also prescribes BAT limits on total suspended solids (TSS).[8]

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[1] 80 Fed. Reg. 67,838 (Nov. 3, 2015).
[2] 80 Fed. Reg. at 67,882.
[3] *Id.*
[4] 80 Fed. Reg. at 67,883; *see* 40 C.F.R. § 423.12(b)(4).
[5] 40 C.F.R. § 423.13(h)(1)(ii).
[6] 82 Fed. Reg. 43,494 (Sept. 28, 2017).
[7] 80 Fed. Reg. at 67,883; *see* 40 C.F.R. § 423.12(b)(4).
[8] 40 C.F.R. § 423.13(k)(1)(ii).

- Due to a recent postponement rulemaking by EPA, the new, more stringent limits under the revised ELG for wet flue gas desulfurization (FGD) wastewaters will be applied to dischargers on a date to be set by the permitting authority that is as soon as possible beginning November 1, 2020, but no later than December 31, 2023.[9] The rule provides that discharges of this wastestream before the chosen applicability date should be subject to limitations based on the previously promulgated BPT limitations or the plant's other applicable permit limitations (e.g., any water quality-based effluent limitations) until at least November 1, 2020, or later if dictated by the selected applicability date.[10] In this interim time period until the selected applicability date, the rule also prescribes BAT limits on total suspended solids (TSS).[11]

TVA's Kingston Fossil Plant (KIF) is subject to the ELGs and the new limits for wet FGD wastewaters and fly ash and bottom ash transport waters. Other limitations such as those for low volume wastes, metal cleaning wastes, and combustion residual leachate also apply.

Under the revised ELG rule, the Tennessee Department of Environment and Conservation (TDEC) must set in the next renewal NPDES permit issued for the KIF facility stream-by-stream applicability dates for the identified limits on wet FGD wastewaters, fly ash transport waters, and bottom ash transport waters. As noted above, these applicability dates must be "as soon as possible beginning November 1, 2018, but no later than December 31, 2023" for fly ash transport waters and "as soon as possible beginning November 1, 2020, but no later than December 31, 2023" for bottom ash transport waters and FGD wastewaters.[12] The rule defines "as soon as possible" to mean November 1, 2018, for fly ash transport waters and November 1, 2020, for bottom ash transport waters and FGD wastewaters, unless TDEC establishes a later date, after receiving information from TVA, which reflects consideration of the following factors:

- Time to expeditiously plan (including to raise capital), design, procure, and install equipment to comply with the ELG;
- Changes being made or planned at the plant in response to emission guidelines for greenhouse gases from existing fossil-fueled electric generating units (i.e., the Clean Power Plan) or regulations that address the disposal of coal combustion residuals (CCR) as solid waste (i.e., the CCR Rule);
- For FGD wastewater requirements, an initial commissioning period for the treatment system to optimize the installed equipment; and
- Other appropriate factors.[13]

This document discusses the factors relevant to TVA and specifically applicable to the KIF facility that are intended to inform TDEC's determination of appropriate applicability dates for wet FGD wastewaters and fly ash and bottom ash transport waters at KIF to be implemented via the renewed NPDES permit. TVA is proposing applicability dates herein that reflect the complexity of the various projects and the potential issues that could hamper imposition of earlier dates.

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[9] 82 Fed. Reg. 43,494 (Sept. 28, 2017).
[10] 80 Fed. Reg. at 67,883; 40 C.F.R. § 423.12(b)(11).
[11] 40 C.F.R. § 423.13(g)(1)(ii).
[12] 40 C.F.R. §§ 423.13(g)(1)(i), (h)(1)(i), (k)(1)(i) (as amended by 82 Fed. Reg. 43,494).
[13] 40 C.F.R. § 423.11(t) (as amended by 82 Fed. Reg. 43,494).

In setting applicability dates, it is also relevant to consider EPA's statements in its postponement rule related to implementation dates for the new, more stringent limits associated with BATW and FGD wastewaters. In that rulemaking, EPA stated that delaying the "as soon as possible" implementation date for these wastewater streams until November 1, 2020, at the earliest is intended to "prevent the potentially needless expenditure of resources during a rulemaking that may ultimately change the 2015 Rule in these respects."[14] EPA acknowledged that some planning and capital expenditures may occur associated with activities undertaken in the near-term (e.g., engineering design, equipment acquisition, shipping, site preparation) that ultimately might not be necessary as a result of the reconsideration.[15] However, EPA's intention expressed in the rulemaking is to "preserve the regulatory status quo" for these wastestreams "until the new rulemaking is complete" and not require utilities to expend more significant capital costs in the near-term that may ultimately be unnecessary as a result of EPA's reconsideration of the 2015 ELG Rule.

TVA uses a three-phase project process: Phase 1 is the study phase, Phase 2 is the design phase, and Phase 3 is the construction/implementation phase. Further details on the activities occurring in each phase are described below for the various wastewater streams.

I. TVA Fleet-wide Considerations & Early Activities

TVA initiated work to implement the ELGs on several fronts including initiating a Phase I study at a coal-fired site in Kentucky prior to the publication of the final ELGs in November 2015. TVA began the contracting process with wastewater treatment (WWT) engineering and design vendors for the other five remaining TVA coal-fired sites in late 2015 once the new ELGs were published. After preparing the workscopes for these sites, TVA then sent out requests for proposals (RFPs) for WWT engineering services in January 2016.

Other early work that TVA has been engaged in for ELG compliance has pertained to technology evaluations, initial wastewater characterization, and other preliminary engineering work. Technology assessments have focused primarily on selenium removal in wet FGD wastewater and have occurred mostly through active participation in projects conducted by the Electric Power Research Institute (EPRI) such as:

- Funding EPRI studies of GE ABMET efficacy for selenium treatment at a Powder River Basin coal-fired site;
- TVA-funded project for bench-scale testing Liberty Hydro (biological alternative treatment) for selenium removal at TVA's Paradise Fossil Plant in Kentucky;
- EPRI project to assess the existing physical-chemical WWT facilities at TVA's Kingston Fossil Plant for mercury and arsenic removal;
- Follow-on EPRI project at Kingston to evaluate biological treatment for selenium (in addition to installing a chemical precipitation pilot);

[14] 82 Fed. Reg. at 43,496.
[15] *Id.* at 43,497.

- Participation in EPRI sampling project to assess water quality for bottom ash transport water at TVA's Bull Run Fossil Plant to determine suitability for wet FGD makeup;
- Participation in an EPRI sponsored test to evaluate a sulfite sensor to improve wet FGD process control at TVA's Cumberland Fossil Plant; and
- Participation in EPRI sponsored testing for changes in wet FGD wastewater due to the Mercury and Air Toxics Standards rule.

In order to meet the limits in the 2015 ELGs, TVA must evaluate and implement new WWT projects for several wastewaters at six coal sites planned to remain active, including KIF. The capital and operations and maintenance (O&M) expenditures for new WWT will be considerable.

There also will be a large number of WWT projects that will occur at approximately the same time as CCR Rule-related projects; these activities require careful coordination at the affected sites to ensure that one project's decisions do not adversely affect another project's outcome. Another factor for consideration in the development of these applicability dates is that, with the amount of industrial construction occurring on a near-simultaneous basis in the U.S. for various environmental projects, there is likely to be a significant shortage of skilled trades and labor craftsmen.

TVA is facing a fairly severe economic climate for fiscal year 2018 (FY18) that begins October 1, 2017, such that there is a need to defer certain projects in order to address these economic conditions and to accommodate the sheer number of ongoing projects at TVA. During FY18, there will be approximately 70 projects in the TVA Civil Projects group alone which include landfill development, pond closures, gypsum dewatering and continuation of progress in wet FGD wastewater treatment, etc. Additionally, TVA has made significant investments in new gas and renewables generation. There was also a major effort related to the February 2017 event at Cumberland in which there was a collapse of a coal storage silo; personnel were required to inspect 21 coal storage silos at Cumberland and silos of similar construction at Paradise Fossil Plant in Kentucky that resulted in extended outage durations at those sites. In addition to these known issues, there is still substantive and temporal uncertainty around implementation of the CCR Rule and Commissioner's Order OGC15-0177, including determining acceptable closure methodology and other corrective measures that will be implemented for closure of TVA's surface impoundments. TVA's capital spend plan would be drastically affected by implementation of closure-by-removal methodologies, which are much lengthier and costlier project approaches. TVA is also mindful of the difficulties associated with operation of the complex WWT technology required under the ELGs. (See "FirstEnergy Corp. has indefinitely shut down two of its three power generating units at Bruce Mansfield Power Station after encountering problems with its $200 million dewatering facility.")

In proposing these applicability dates for KIF's wastestreams, TVA has carefully considered the significant capital requirements and associated annual cash flows. TVA's expansive project portfolio, including CCR pond closures and our commitment to conversion to dry CCR disposal, makes properly planning cash flows critical to fulfilling

TVA's mission and keeping electric rates low. The ELGs allow consideration of this factor, which is a capital raising issue.[16]

The proposed applicability dates would allow TVA to conduct some design and construction activities associated with wet FGD WWT for selenium (i.e., biological or biological alternative treatment) in later fiscal years. At KIF, there are currently solids removal clarifiers to which some treatment chemicals are added. More near-term projects include optimization of the chemical feed systems to better address feed rates as well as further promoting redundancy. For the no discharge of bottom ash transport water limit/requirement, the proposed applicability date reflects the construction of the water recirculation portion of bottom ash transport water WWT projects in later fiscal years. TVA is committed to proceeding with the dewatering projects for bottom ash at KIF which is already in progress, allowing TVA to complete conversion to dry disposal of CCRs at KIF in 2018.

In addition, as work has progressed on wet FGD wastewater treatment and bottom ash dewatering studies, it has become more apparent that there are also new developments and technical issues to resolve in order to reliably meet the new ELGs for wet FGD WWT and no discharge of BATW. For example, more time is needed to resolve issues such as those presented in the study by EPRI published after the revised ELGs were finalized that indicated that Powder River Basin (PRB) coal is not amenable to biological treatment to achieve the 2015 ELGs. KIF is currently burning a blend of Illinois Basin and PRB coal, so the concerns raised by the EPRI report are relevant. Another critical technical issue to resolve, which EPRI is currently investigating, is instream process monitoring. Unfortunately, there are not yet robust, reliable methods to measure selenium and other constituents for process control to ensure that discharge concentrations will be in compliance with 2015 ELGs.

In a positive development, testing of the sulfite analyzer at Cumberland was shown to be very successful in mitigating oxidation of selenium to selenate. TVA is completing a Phase 1 study on installing the analyzers for process control at Cumberland. TVA recently began a project to evaluate the feasibility of using sulfite analyzers in the KIF FGD to improve FGD process control to improve efficacy of selenium treatment. Unfortunately, TVA was unable to complete this project, as described below, so additional analysis will be required for KIF.

In addition to the wet FGD WWT issues, there is uncertainty about the cycling up of constituents and the quantity of blowdown required to maintain cycle chemistry in the bottom ash transport no discharge loop. There are also concerns about whether the bottom ash transport water can be reused for wet FGD makeup since this may cause issues with wet FGD operation or wet FGD wastewater treatment. The other pre-approved use for bottom ash transport water blowdown is for ash conditioning. However, when fly ash is marketed for reuse, it is not typically wetted, and this is the case at KIF. Therefore, the amount of BATW needed to be blown down may exceed the amount needed for approved uses at KIF. It is not expected that wet FGD makeup will consume all amounts of bottom ash blowdown so advanced bottom ash WWT may be required in order to meet a no discharge requirement.

[16] 40 C.F.R. § 423.11(t)(1).

TVA is also somewhat unique compared to investor-owned utilities in that, as a federal agency, it is subject to the National Environmental Policy Act (NEPA). The Endangered Species Act and the National Historic Preservation Act also include sections with federal agency-specific requirements. TVA is planning to conduct much of the required environmental review under these statutes simultaneously with the detailed design stage (Phase 2) of WWT; however, projects can be subject to delays presented by the environmental review process itself or as a result of required mitigation that results from that process. For example, types of delays that can occur include avoiding construction during certain periods to protect threatened or endangered species such as bats or bird species. For this reason, TVA has included appropriate schedule contingency in each of the WWT facility project schedules to address potential delays due to environmental reviews or other construction delays, the specifics of which cannot be reasonably foreseen at this time.

II. Wastewater Treatment Facilities at Kingston

The types of wastewaters requiring new treatment or handling facilities for compliance with the 2015 ELGs, pending EPA's reconsideration and possible revision, include additional wet FGD wastewater treatment and completion of the conversion to a no discharge of bottom ash transport water system (while still allowing the limited exceptions provided for by EPA for FGD makeup and fly ash conditioning).

TVA has contracts with engineering firm(s) to establish workable preliminary conceptual schedules, costs, etc. to support proposed ELG applicability dates for the various wastewaters at KIF. Based on these preliminary schedules and TVA's assessment of other relevant factors such as environmental review requirements, appropriate minimum proof-of-concept testing schedules for wet FGD wastewaters as well as preferred overlapping test periods for vendors, TVA's proposed applicability dates and the associated justifications are presented below.

A. Wet FGD Scrubber Wastewaters

EPA determined that the best available technology (BAT) for treatment of wet FGD wastewater is chemical precipitation followed by biological treatment. New ELGs for wet FGD wastewater were established for arsenic, mercury, selenium, and nitrate/nitrite based on these basis technologies. (EPA does not, however, regulate the type of equipment required to be used to comply with ELGs.)

Kingston operates a once-through, high-flow wet FGD scrubber. The existing materials of construction in the KIF FGD limit the ability to recycle flow back to the scrubber absorber, which would reduce the overall volume of wastewater to be treated. The materials of construction are not resistant to chlorides which can concentrate in wet FGDs when water is recycled and cause accelerated corrosion. TVA considered recycling a portion of wet FGD blowdown up to the recommended maximum chlorides concentration for the materials of construction limitations or relining the FGD equipment with corrosion resistant materials in order to significantly reduce the volume of wastewater to treat. However, recycling increases the dissolved constituents and increases wastewater

treatment complexity. The increase in dissolved constituents may inhibit the removal of the target metals regulated by the ELGs. Considerable effort will be required to determine the optimum holistic approach for wet FGD WWT at each wet-scrubbed site; respective advantages and disadvantages will be evaluated in Phase 1 (Study). Based on the evaluation of factors involved at KIF including impacts to gypsum marketability, TVA has decided to proceed with WWT without FGD recycle in order to avoid potential corrosion issues and WWT complexity.

Gypsum dewatering is a necessary first step for wet FGD WWT in order to separate the bulk of the wet FGD solids from this wastestream. KIF currently operates gypsum dewatering and some limited chemical precipitation WWT equipment. The chemical precipitation equipment at the gypsum dewatering plant was originally designed for TSS, oil and grease, and pH limitations that were in the previous steam electric ELGs and to support the dry disposal of wet FGD CCRs. TVA has evaluated the physical-chemical equipment performance at KIF and the targeted monthly average mercury concentration under the 2015 ELGs was not successfully met during that testing. During Phase I (Study), TVA will continue to evaluate the capabilities of the existing chemical precipitation equipment at KIF in achieving the ELGs for mercury and arsenic and for preparing the wastewater for advanced treatment using biological or biological alternative treatment for selenium and nitrate-nitrite.

There are significant concerns about the ability to reliably meet the ELGs for any site; thus TVA will continue to evaluate wet FGD WWT technology options along with the rest of the industry, particularly for selenium. Biological treatment for selenium is not as well-established as chemical precipitation as there are far fewer installations. Extensive site-specific proof-of-concept testing for selenium treatment is vital in making the best WWT decision at KIF in order to comply with very stringent wet FGD ELGs. Proof-of-concept testing for selenium WWT technologies is planned to occur during Phase 2 (Design). TVA, many other utilities, and various WWT engineering providers suggest active testing for each technology that spans a period of at least six months. This allows evaluation to occur over various operational conditions and seasons. It is also preferable to conduct side-by-side testing of various technologies to expose them to identical operating conditions in order to gauge their relative merits. In addition, the proof-of-concept testing must occur at each wet FGD site; one site's results cannot reliably be applied to another site. TVA has seen ample evidence of the unique properties of each wet FGD wastewater. This variability among sites can be due to the type of coals burned/blended, source water and limestone constituent contributions, and overall operational variability. Operational variability can be driven by how the generation units are dispatched (i.e., when and how operated) as well as the operational specifics for each wet FGD, such as the oxygen feed rates, blowdown frequencies, etc. (In fact, FGD operation can be vastly different between absorbers at the same plant due to the particular chemistry found in each absorber, even when the flue gas from all units enters a common exhaust duct and is then split between multiple FGD absorbers.)

Selenium and nitrate/nitrite removal pilot-scale units are likely to be in high demand by the industry. The supply of pilot units is likely to be woefully inadequate, which could potentially cause delays in completing planned proof-of-concept testing and completion of Phase 2 design. The desired side-by-side testing also can be problematic with limited pilot-scale unit availability, so there is additional time built into the schedule to accommodate side-by-side testing for at least part of the time.

EPA also recognizes the need to allow time to optimize, tune, test, and adapt wet FGD WWT to ensure compliance with ELGs after installation of the WWT equipment in Phase 3 (Construct).[17] TVA believes this optimization step is warranted and has allocated a minimum of eight months in Phase 3 for testing and optimization in order to allow sufficient time to troubleshoot and retrofit with additional treatment as necessary.

Existing planned outage schedules must be taken into account when determining the ELG applicability date so that equipment tie-ins can occur during planned outages where feasible. Using planned outages versus requiring additional/special outages for tying in equipment ensures operations occur according to the generation plan which helps maintain electric grid reliability. Consideration of this factor is allowed by and planned for in the ELGs.

Detailed below are the various activities that are expected to occur during each phase of the FGD WWT project and reasonably foreseeable potential difficulties that may impact project schedule.

The task descriptions below include some actions that are in progress.

Project Phase 1 (Study)—Approximately 22 months

Projected Activities: Develop approximate WWT footprint for additional treatment required and preliminary general arrangements, and propose and evaluate alternative treatment approaches and locations, including considerations of impacts presented in the EPRI reporting on PRB coals and WWT treatability using biological treatment. Evaluate feasibility of sulfite analyzer in FGD absorber to improve FGD process control that may impact WWT efficacy. Conduct siting and geotechnical studies for proposed sites as needed to ensure constructability. Develop performance specifications, conceptual budgets and refined schedules. Perform characterization of wet FGD wastewaters and conduct bench/treatability testing. Determine if existing physical-chemical treatment upgrades are needed or if additional secondary treatment for selenium and nitrate/nitrite will address deficiencies in physical-chemical treatment for arsenic and mercury. Conduct characterization of bottom ash transport water and determine suitability of bottom ash transport water for FGD makeup as part of the FGD WWT design group activities. Develop project planning document. Develop Request for Proposal (RFP) documents and initiate RFP process and evaluations to proceed to Phases 2 and 3. Obtain TVA Board approval for project.

Potential Schedule Issues: Delays in the RFP processes (i.e., required extensions, scope clarifications, best and final pricing requests, and contract negations) or other delays.

[17] 40 C.F.R. § 423.11(t)(3).

Project Phase 2 (Design, Proof-of-Concept Testing, and Long Lead Items)—Approximately 35 months

Projected Activities: Develop detailed design drawings/documents including power needs study for WWT. Conduct proof of concept testing for both physical-chemical treatment upgrades as well as biological treatment for wet FGD wastewater for a minimum of 6 months active testing with side-by-side evaluations of technologies. Allow for additional considerations for piloting systems for Powder River Basin (PRB) coal blend wastewater. If determined feasible and results in improved wet FGD process control, complete design for sulfite analyzer. (Note: sulfite analyzer testing was started but not completed during Phase 1 for this project because it was determined that sufficient turndown of oxidation air to the scrubber absorber was not possible; additional work will be needed for confirmatory testing of the sulfite analyzer at KIF during Phase 2.) Complete required environmental reviews (NEPA) and obtain construction stormwater and 404/401/other permits. Initiate the WWT plans approval process with TDEC after 90% design documents have been developed.

Potential Schedule Issues: Challenges to TVA's NEPA documents or permits. Delays in obtaining proof-of-concept equipment from vendors due to high demand. Failure of or difficulties with biological and/or other pilot systems to adequately address PRB-blend discharges. Scarcity or supplier bottlenecks for WWT equipment to be purchased as long lead item procurement could delay completion of Phase II and initiation/completion of Phase 3 (construction).

Project Phase 3 (Construct, Test, Train)—Approximately 38 months

Projected Activities: Wet FGD WWT site preparation and construction including planning for weather delays for construction, establishment of construction stormwater best management practices, installation of wet FGD WWT equipment, piping, power, controls. Start-up of WWT equipment, debugging of processes/controls/software. If test and design are successful for installation of the sulfite analyzer, install analyzers and reprogram controls. Testing and optimization of wet FGD WWT equipment; installation of additional/alternative treatment if necessary. Train operators; troubleshoot and respond to equipment design or reliability issues.

Potential Schedule Issues: Site construction delays due to weather, environmental related issues (e.g., potential "no construction" periods for bird and bat protection). Plant integration of controls, power, piping, etc., and dependence upon planned outages. Potential additional WWT testing due to PRB coal blend.

Proposed Applicability Date for Wet FGD Wastewater ELGs: December 1, 2023

B. Dry Fly Ash System

EPA's ELGs established a no-discharge standard for fly ash transport water for existing plants. KIF currently does not discharge fly ash transport water as defined by the ELGs. The dry fly ash handling system was upgraded in recent years to eliminate the possibility

of wet sluicing the fly ash as a backup transport mechanism. This was accomplished in support of TVA's effort to eliminate wet disposal of CCRs. KIF has achieved compliance with the no-discharge standard for fly ash transport water. In accordance with the ELGs, the default applicability date for no discharge of fly ash transport water should be established as November 1, 2018.

C. Bottom Ash Transport Water Upgrades

The 2015 ELGs established a no-discharge standard for bottom ash transport water. EPA determined that BAT for this wastestream is a dry handling or a closed-loop system that recycles flow from the dewatering process.

For KIF, TVA installed an interim tank-based bottom ash dewatering system in order to eliminate the wet disposal of this CCR. This system was completed in early fall of 2015; however, it is not currently a no-discharge system and is planned to be replaced. TVA is currently installing a remote submerged flight conveyor system and will design and build the recirculation portion separately. TVA has separated the activities necessary to achieve the no-discharge standard into separate projects in order to balance project workload. These projects are separated into field activities for the construction of a dewatering facility and plant tie-ins to accommodate the recirculation/no discharge aspect. Both the dewatering and the recirculation pieces must be in place in order to achieve the no-discharge requirement of the ELGs.

EPA does allow certain uses for bottom ash transport water such as FGD makeup water and fly ash conditioning to prevent dusting. As part of completing the design to make the BATW system a no-discharge system, TVA will determine whether all flows could be used solely for bottom ash transport, or whether a portion of that water would have to be blown down and would be suitable for FGD makeup water or fly ash conditioning or other no discharge application as allowed by EPA. This determination will involve evaluating flows and characterizing chemical constituents to ensure that operational problems or system damage does not occur. Such problems could result from characteristics of the bottom ash transport water such as fines that could erode pipes or equipment or from chemical constituents that could interfere with scrubber operations or that could prevent gypsum crystals from forming. Another issue is that fly ash may not be wetted if it is marketed for reuse in cement; this eliminates fly ash conditioning as a potential "sink" for bottom ash transport blowdown. KIF currently markets its fly ash; therefore, bottom ash blowdown "disposal" as fly ash conditioning is not currently an option. After characterizing the bottom ash transport water, TVA will be able to determine the best reuse option.

Further evaluation is necessary at KIF since economizer ash is combined with the bottom ash stream. While this is permitted under the ELGs, it may make the bottom ash transport cycle chemistry more complex by introducing constituents that are prone to concentrate and are not amenable to primary treatment, which could cause issues with BATW system corrosion, etc. This issue combined with the potential lack of sufficient "sinks" for the blowdown may require advanced wastewater treatment (e.g., thermal evaporation or reverse osmosis or other volume reduction) or no discharge application in order to eliminate discharge of bottom ash transport waters. TVA will evaluate economizer ash inclusion to determine if projects to segregate handling of these

materials from bottom ash should be initiated. TVA needs sufficient time to determine the impacts of inclusion of economizer ash.

Existing planned outage schedules must be taken into account when determining the applicability date so that the dewatering system can be tied into the powerhouse. Consideration of this factor is allowed by and planned for in the ELGs in order to maintain electric grid reliability. KIF is slightly more complex than some other bottom ash no discharge systems that TVA would have to install as KIF has 9 units to consider.

The task descriptions below include some actions that are in progress.

Project Phase 1 (Study)—Approximately 15 months

Projected Activities: Conduct siting and geotechnical studies for proposed equipment. Develop vendor performance specifications, conceptual budgets and refined schedules. Develop project planning documents. Study inclusion of other streams in bottom ash transport water to determine if a segregation project should be implemented to improve cycle chemistry.

Potential Schedule Issues: Delays in the Request for Proposal processes (i.e., required extensions, scope clarifications, best and final pricing requests, and contract negations). Multiple vendors may be involved if segregation projects are determined to be the best solution.

Project Phase 2 (Design and Long Lead Items)—Approximately 18 months

Projected Activities: Develop detailed design drawings/documents including a power needs study for equipment. Complete environmental reviews as required by NEPA and obtain construction stormwater and 404/401/other permits based on design documents. Develop design documents for segregation of other streams as applicable.

Potential Schedule Issues: Delays in permitting, challenges to NEPA documents, and scarcity of long lead equipment or supplier bottlenecks for long lead equipment may cause delays. Interface between multiple vendors with different design tasks.

Project Phase 3 (Construct & Commission)—Approximately 58 months

Projected Activities: (Bottom ash dewatering project is already in progress, and the total duration reflects past activities.) Site preparation, construction including establishment of construction stormwater best management practices, installation of equipment, piping, power, controls. Complete plant tie-ins, working around planned outage schedules for 9 units, and (for the recirculation project) ensuring water balance supports no discharge. Perform start-up, testing, and optimization of system. Complete segregation projects for bottom ash water quality improvements if warranted. Installation of additional equipment if necessary to achieve no discharge ELG.

Potential Schedule Issues: Site construction delays due to weather, environmental issues (e.g., potential "no construction" periods for bird and bat protection). Plant integration of controls, power, piping, etc., and dependence upon planned outages including for potential bottom ash segregation projects. There are 9 units at KIF, and as a result, planned outage tie-ins are more numerous.

Proposed Bottom Ash No-Discharge Applicability Date: December 1, 2023

D. Legacy Wastewater

The ELGs also address appropriate limits for legacy wastewater, which the rule defines as wet FGD wastewater, fly ash transport water, bottom ash transport water, and certain other wastewaters generated prior to the applicability date for the new limits determined by the permitting authority for each of these streams.[18] Legacy wastewater at KIF will be subject to limits on total suspended solids (TSS), oil and grease (O&G) and pH that will apply to wet FGD wastewater, fly ash transport water, and bottom ash transport water generated before the new ELG applicability dates selected by TDEC for each of these wastestreams.[19] Due to the CCR Rule, various impoundments are or will be subject to closure. TVA is evaluating remaining basins to be utilized for treatment of legacy wastewaters and general plant flows to the extent practicable.

E. General Plant Flows

In addition to wet FGD wastewater and fly ash and bottom ash transport waters, the KIF facility includes a number of other general plant flows. TVA is using the term general plant flows to refer to several types of wastewater including coal pile runoff, low volume wastes, combustion residual leachate, and chemical and nonchemical metal cleaning wastes with established ELGs. The ELG does not allow the permitting authority to determine future applicability dates for these flows, but they are included in this document for completeness.

Much of the plant's general plant flows are collected and treated in the site's clean water trench and Process Water Basin (PWB) that were recently constructed. These flows are routed to Outfall 001. In addition, some general plant flows are routed to the Process Water Basin (formerly named the stormwater pond) at the Gypsum Disposal Facility and discharge via Outfall 01A. Additional WWT may be necessary at these PWBs in the future; such as pH control or polymer injection. State approvals of the additives and/or treatment modifications are also required prior to implementation.

Chemical metal cleaning wastes will be collected in appropriate tanks and any hazardous portions will be disposed of as hazardous wastes. The non-hazardous fraction of chemical cleaning wastes will be discharged in accordance with limits in the NPDES permit on TSS, O&G, pH, copper, and iron.

[18] 80 Fed. Reg. at 67,854-55.
[19] 80 Fed. Reg. at 67,854-55, 67,895-96; 40 C.F.R. §§ 423.13 (g)(1)(ii), (h)(1)(ii), (k)(1)(ii).

Non-chemical metal cleaning wastes will continue to be discharged in accordance with historical limits in the NPDES permit. As established in the ELGs and prior NPDES permits, non-chemical metal cleaning wastes were formerly treated as low volume wastes (LVW) subject only to TSS, O&G and pH limitations and not copper and iron limitations. TVA believes that continuation of these current LVW limitations is appropriate.

III. Conclusion

The following table summarizes appropriate ELG applicability dates for each type of wastewater, accounting for all of the necessary planning, design, and implementation activities and other factors described above.

Table 1. ELG Applicability Date Summary

Wastewater Stream	Limits	Proposed Applicability Date
Wet FGD Wastewater	Arsenic (8, 11 ug/L), Mercury (365, 788 ng/L); Se (12, 23 ug/L), N/N (4.4, 17 mg/L) TSS (30,100 mg/L); O&G (15, 20 mg/L); pH (6-9)	December 1, 2023 Applicable now
Fly Ash Transport Water	No discharge	November 1, 2018
Bottom Ash Transport Water	No discharge; exceptions for wet FGD makeup, use for fly ash conditioning, and small quantities due to line repair TSS (30,100 mg/L); O&G (15, 20 mg/L); pH (6-9)	December 1, 2023 Applicable now
Combustion Residual Leachate	TSS (30,100 mg/L); O&G (15, 20 mg/L); pH (6-9)	Date of permit issuance
Low Volume Wastes	TSS (30,100 mg/L); O&G (15, 20 mg/L); pH (6-9)	Applicable now
Chemical metal cleaning wastes	TSS (30,100 mg/L); O&G (15, 20 mg/L); pH (6-9); Copper (1, 1 mg/L); Iron (1, 1 mg/L)	Applicable now
Nonchemical metal cleaning wastes	TSS (30,100 mg/L); O&G (15, 20 mg/L); pH (6-9)	Applicable now

These proposed applicability dates are based on EPA's latest actions with respect to the implementation of the ELG Rule. *See* 82 Fed. Reg. 43,494. Should EPA take subsequent action with respect to the limits or implementation timelines in the rule, those changes should be taken into account in the permitting of TVA's facilities.

For example, should EPA revise its postponement decision between now and issuance of the final NPDES permit to provide for an indefinite postponement of the implementation of limits for bottom ash transport waters and/or FGD wastewaters while it is reconsidering those limits, TDEC should not impose an "as soon as possible" applicability date for those wastestreams in the renewal permits. In that situation, TDEC should impose only the applicable BPT limits on TSS, Oil and grease, and pH, as well as the interim BAT limits on TSS. EPA Region 1's plan for the NPDES permit at the Merrimack Station, which was released prior to EPA's ELG implementation postponement rule, reflects an appropriate course of action in the event of an indefinite postponement of implementation deadlines.[20] In its Statement of Substantial New Questions for Public Comment for the Merrimack Station NPDES Permit No. NH0001465, EPA stated:

> [T]he new ELGs also establish less stringent BAT limits that apply to FGD wastewater discharges *prior to* the applicable deadline for compliance with the more stringent BAT limits. Specifically, for the discharges for FGD wastewater prior to the final BAT compliance deadlines, the 2015 Steam Electric ELGs set 'interim' BAT limits that address only TSS. These BAT limits for TSS match the BPT limits for TSS in 40 C.F.R. § 423.12(b)(11)." (internal citations omitted)[21]
>
> EPA has postponed [the "as soon as possible"] compliance deadline. . . . **With the compliance date for the zero discharge limit postponed and the ELGs under reconsideration, 40 C.F.R. § 423.13(k)(1)(i), EPA cannot incorporate that limit into Merrimack Station's final permit.** In the absence of the zero discharge limits, the 2015 Steam Electric ELGs prescribe the interim BAT effluent limits for TSS . . . . These interim BAT limits have not been postponed or stayed. Therefore, under the 2015 Steam Electric ELGs that are currently in effect, BAT limits—equal to the TSS limits listed in § 423.12(b)(4)—apply to bottom ash transport water discharges." (emphasis added; internal citations omitted)[22]

In addition, because of the possibility for revision of the applicable technology-based limits and implementation deadlines due to EPA's reconsideration of the rule or other intervening EPA actions, TDEC should acknowledge in the KIF NPDES permit that these issues are in flux and should commit to reopening the permit to apply any new limits and implementation deadlines promulgated by EPA during the term of the permit.

In each case of new applicability dates as shown above, TVA is requesting these applicability dates be established at the beginning of a monitoring period due to sampling and discharge monitoring report (DMR) reporting considerations.

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[20] EPA Region 1's Statement of Substantial New Questions for Public Comment for the Merrimack Station NPDES Permit No. NH0001465), (https://www3.epa.gov/region1/npdes/merrimackstation/pdfs/2017-statement-snqpc.pdf).
[21] *Id.* at 50.
[22] *Id.* at 60.

APPENDIX 4 – Stilling Pond Dewatering

From: Love, Bradley Michael
To: Vojin Janjic; Elizabeth Rorie
Cc: Robert Alexander; Natalie Harris
Subject: TVA - KIF - NPDES Permit No. TN0005452 - Stilling Pond Management Plan
Date: Wednesday, October 19, 2016 8:14:34 AM

***** This is an EXTERNAL email. Please exercise caution. DO NOT open attachments or click links from unknown senders or unexpected email - STS-Security. *****

Mr. Janjic –

Please find attached notification of TVA's plans to perform drawdown in support of stilling pond closure at Kingston. Activities described in the attached letter are planned to begin as soon as construction of the new polishing pond is complete and placed in service. Based on the current project schedule, stilling pond drawdown could commence as early as the last week in November 2016. Please let me know if you have any question or comments on this communication.

Thanks,

Brad Love
Water Permits, Compliance & Monitoring
Tennessee Valley Authority
1101 Market Street, BR 4A | Chattanooga, TN 37402
☎ 423.751.8518 | 🖷: 423.751.7011 | ✉: bmlove@tva.gov

Tennessee Valley Authority, 1101 Market Street, BR4A, Chattanooga, Tennessee 37402

October 19, 2016

Mr. Vojin Janjić
Division of Water Resources
Tennessee Department of Environment
and Conservation
William R. Snodgrass Tennessee Tower
312 Rosa L. Parks Avenue, 11th Floor
Nashville, Tennessee 37243

TENNESSEE VALLEY AUTHORITY (TVA) – KINGSTON FOSSIL PLANT (KIF) – NPDES PERMIT NO. TN0005452 – STILLING POND MANAGEMENT PLAN

TVA is currently constructing a new polishing pond at KIF, which will take the place of the existing stilling pond, for final treatment of certain power plant wastewaters prior to discharging through NPDES Outfall 001. The polishing pond is expected to be complete and in service by December 31, 2016. Once the polishing pond has been placed in service, TVA plans to begin closure of the stilling pond.

To facilitate implementation of the closure plan design, TVA will begin preliminary activities as authorized in Paragraph VII.D.4 of Commissioner's Order OGC15-0177 as soon as the polishing pond becomes operational. Stilling pond drawdown flows will continue to be discharged through Outfall 001 and an operational pool lowering plan will be implemented during the activity to ensure wastewater discharges from Outfall 001 continue to maintain compliance with the NPDES permit and remain protective of in-stream water quality. The operational pool lowering plan will continue to be implemented until contact water within the stilling pond has been eliminated.

TVA collected water quality samples from within the stilling pond at two separate locations and depths. Samples were collected near the surface at an approximate depth of two feet and near the bottom at an approximate depth of 12 feet. The pond depth to top of sediment at each sampling location was approximately 14 feet. As a conservative approach, TVA utilized the maximum constituent concentrations detected from the sampling event and maximum expected discharge flow rate during regulated low flow conditions (1Q10) in the receiving stream to calculate the expected in-stream concentration during drawdown. Calculated in-stream constituent concentrations also take into account contributions from wastewaters which will continue to discharge from plant operations contributing to Outfall 001 and Outfall 01a. For additional conservatism, mixing and dilution provided by Outfall 002 flows are not included in the calculations. The results of the in-stream calculations are presented in Enclosure 1, which TVA believes demonstrates no appreciable impacts to in-stream water quality during the drawdown period.

Effluent from the stilling pond drawdown will be pumped into the lined sluice ditch where flows will comingle with new power plant wastewaters and undergo treatment with approved coagulants, as necessary, prior to entering the polishing pond. Wastewaters will continue to discharge through the existing Outfall 001 into the KIF intake in accordance with existing limits. Stilling pond drawdown flows will be limited to ten million gallons per day. This maximum flow value for drawdown was used to calculate the expected in-stream concentration during low flow conditions found in Enclosure 1 and as a conservative measure to demonstrate protection of the receiving stream. The calculations in Enclosure 1 also take into account constituent loading from wastewaters during continued power plant operations discharging to Outfall 001 and Outfall 01a.

As part of the operational pool lowering plan, TVA will increase monitoring for parameters in the Outfall 001 NPDES permit limits table and begin monitoring for metals which will be reported with the monthly discharge monitoring reports to demonstrate compliance with the permit and applicable in-stream water quality standards. As a best management practice, water quality instrumentation will also be installed to provide continuous monitoring for turbidity and total dissolved solids (TDS) of the stilling pond drawdown effluent. The operational pool lowering plan will include action values based on data collected from the continuous water quality instrumentation to advise the project of treatment thresholds. Enclosure 2 includes a list and frequency of parameters which will be sampled during stilling pond drawdown. Consistent with the TDEC letter to TVA dated June 9, 2011, deleting the requirement to maintain and report the ash pond free water volume, TVA will manage the reduction of free water within the ash pond to meet NPDES permit limits at Outfall 001. For contingency planning, TVA may utilize filtration or approved coagulants to promote settling of solids prior to discharge, as necessary.

In summary, drawdown discharges from the stilling pond as described herein are comparable to and would have no greater impacts than normal operations under the KIF NPDES permit. Pollutants of concern are limited and will be monitored at an increased frequency during stilling pond drawdown and subsequent discharge at Outfall 001. TVA does not believe there will be appreciable impacts to the receiving stream during the drawdown period and that in-stream water quality standards will be protected.

If you have any questions or need any additional information, please contact Brad Love at (423) 751-8518 in Chattanooga, or by e-mail at bmlove@tva.gov.

Sincerely,

Terry E. Cheek
Senior Manager
Water Permits, Compliance, and Monitoring

Enclosures

Mr. Vojin Janjić
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October 19, 2016

Enclosures
cc: Mr. Michael Atchley
Knoxville Environmental Field Office
Tennessee Department of Environment
and Conservation
3711 Middlebrook Pike
Knoxville, Tennessee 37921

Enclosure 1
TVA - Kingston Fossil Plant
NPDES Permit Number TN0005452
Calculated In-stream Constituent Concentrations Based on 1Q10 Flows

Parameter	Measured Ash Pond Concentration (mg/L)	Outfall 001 Concentration[8] (mg/L)	Outfall 01a Concentration[9] (mg/L)	Intake Concentration[10] (mg/L)	Calculated In-stream Concentration (mg/L)	TN In-stream WQC (mg/L)
Mercury, Total	0.00000178	0.00000258	0.00193	0.00000385	0.0000207	0.00005
Aluminum	0.298	0.312	< 0.100[3]	0.155	< 0.174	0.750[5]
Copper, Total	0.00361	0.00342	< 0.020[3]	0.00201	< 0.0022	0.013[6]
Lead, Total	< 0.00200[3]	< 0.00200[3]	< 0.020[3]	< 0.00200[3]	< 0.0020	0.005
Selenium, Total	< 0.00200[3]	< 0.00200[3]	0.921	< 0.00200[3]	< 0.00914	0.050
Arsenic, Total	0.00466	0.00322	0.0386	< 0.00200[3]	< 0.00171	0.010
Cadmium, Total	< 0.00100[3]	< 0.00100[3]	0.0196	< 0.00100[3]	< 0.000669	0.005
Chromium, Total	< 0.00200[3]	< 0.00200[3]	0.0592	< 0.00200[3]	< 0.00151	0.1
Iron, Total	0.341	0.169	< 0.100[3]	0.179	< 0.186	1.000[7]
Silver, Total	< 0.00200[3]	< 0.00200[3]	< 0.00200[3]	< 0.00200[3]	< 0.00200	0.0032[6]
Antimony	< 0.00200[3]	< 0.00200[3]	< 0.00200[3]	< 0.00200[3]	< 0.00200	0.0056
Barium	0.119	0.0706	0.193	0.0409	0.0488	2.00
Beryllium	< 0.00200[3]	< 0.00200[3]	< 0.00200[3]	< 0.00200[3]	< 0.00200	0.004
Nickel	< 0.00200[3]	< 0.00200[3]	0.0462	< 0.00200[3]	< 0.00140	0.100
Thallium	< 0.00200[3]	< 0.00200[3]	< 0.020[3]	< 0.00200[3]	< 0.00200	0.000240
Zinc	< 0.0250[3]	< 0.0250[3]	1.15	< 0.0250[3]	< 0.0224	0.120[7]
Cyanide	< 0.0100[3]	< 0.0100[3]	0.071	< 0.0100[3]	< 0.00558	0.140
Nitrate/Nitrite	0.256	< 0.0100[3]	5.81	0.13	< 0.178	10

1. Calculations are based on a maximum decant flow rate of 10 million gallons per day (MGD).
2. Low flow stream condition (1Q10) is 155.8 MGD. Calculations do not take into account any mixing or dilution flow provided by Outfall 002.
3. For parameters which were not detected during the sampling period, half of the reporting level was used for calculating in-stream concentration.
4. Tennessee In-stream Water Quality Criteria from TN Chapter 0400-40-03.
5. EPA National Recommended Freshwater Criterion Maximum Concentration (acute) criterion.
6. Tennessee Criterion Maximum Concentration (acute) criterion.
7. EPA National Recommended Freshwater Chronic Continuous Concentration criterion.
8. Data for Outfall 001 is from 24-hour composite samples collected for Form 2C on June 29, 2016. The average flow of Outfall 001 (14 MGD) from January 2015 to July 2016 was utilized for calculation.
9. Data for Outfall 01a is from 24-hour composite samples collected for Form 2C on June 29, 2016. The maximum design flow of Outfall 01a (1.605 MGD) was utilized for calculation.
10. Data for the intake is from 24-hour composite samples collected for Form 2C on June 29, 2016.

Enclosure 2
TVA - Kingston Fossil Plant
NPDES Permit Number TN0005452
Stilling Pond Management Plan

Effluent monitoring during Stilling Pond drawdown will be conducted at Outfall 001 in accordance with the following:

Outfall 001		
Parameter	**Measurement Frequency**	**Sample Type**
Flow	1/Week	Measured
Oil and Grease	1/Week	Grab
pH	1/Week	Grab[2]
Total Suspended Solids	1/Week	Grab
Mercury, Total	1/Week	Grab[3]
Methyl Mercury	1/Week	Grab[3]
Aluminum	1/Week	Grab
Hardness	1/Week	Grab
Copper, Total	1/Week	Grab
Lead, Total	1/Week	Grab
Selenium, Total	1/Week	Grab
Arsenic, Total	1/Week	Grab
Cadmium, Total	1/Week	Grab
Chromium III	1/Week	Grab
Chromium VI	1/Week	Grab
Chromium, Total	1/Week	Grab
Iron, Total	1/Week	Grab
Silver, Total	1/Week	Grab
Antimony	1/Week	Grab
Barium	1/Week	Grab
Beryllium	1/Week	Grab
Nickel	1/Week	Grab
Thallium	1/Week	Grab
Zinc	1/Week	Grab
Cyanide	1/Week	Grab
Ammonia (as N)	1/Week	Grab
Nitrate/Nitrite	1/Week	Grab

1 - Flow will be reported in Million Gallons per Day (MGD).
2 - pH analysis shall be performed within fifteen (15) minutes of sample collection.
3 - Mercury monitoring will be performed in accordance with Title 40, CFR Part 136, using sufficiently sensitive methods.

ATTACHMENT B

Biological Monitoring of the Clinch River Near Kingston Fossil Plant Discharge, Autumn 2015

May 2016

Tennessee Valley Authority
River and Reservoir Compliance Montoring
Knoxville, Tennessee

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Acronyms and Abbreviations

ATL	Alternate Thermal Limit
BIP	Balanced Indigenous Population
CCW	Condenser cooling water
CRM	Clinch River Mile
CWA	Clean Water Act
ERM	Emory River Mile
KIF	Kingston Fossil Plant
QA	Quality Assurance
RBI	Reservoir Benthic Index
RFAI	Reservoir Fish Assemblage Index
SAHI	Shoreline Aquatic Habitat Index
TRM	Tennessee River Mile
TVA	Tennessee Valley Authority
REH	Reservoir Ecological Health monitoring program

Executive Summary

In 2015, samples of the ecological community upstream and downstream of Kingston Fossil Plant (KIF) were collected, analyzed, and compared to historical data to determine any effects of the thermal effluent from the plant in compliance with §316(a) of the Clean Water Act.

Shoreline aquatic habitat was assessed along both banks at sites upstream and downstream of KIF during 2015. The average rating for all sections of shoreline assessed was "Fair". No aquatic macrophytes were found on either shoreline upstream. Downstream, aquatic macrophytes were found along an average of 13.0% of the shoreline assessed on the left descending bank; no aquatic macrophytes were found on the right descending bank. Assessment of river bottom habitat indicated that silt and detritus were the most common substrates by proportion both upstream and downstream. Gravel and mollusk shell were present at both sites in similar proportions.

RFAI scores differed between the sites upstream and downstream of KIF by four points during autumn 2015. The two sites were similar in diversity, sustainability, and impact from pollution tolerant species, but showed high proportions of non-indigenous species and different trophic compositions. The difference in scores was within the acceptable range of variation (six points) and the fish community at the downstream site met the requirements of a balanced indigenous population. Benthic macroinvertebrate communities at both downstream sites were considered similar to the upstream benthic community. All three sites received RBI ratings of "Excellent". Visual wildlife surveys showed similar types and numbers of wildlife upstream and downstream of KIF.

Water quality parameters measured – water temperature, conductivity, dissolved oxygen concentration, and pH – were similar and within acceptable ranges upstream and downstream of KIF.

It was thus concluded that the downstream site was not adversely affected by operation of KIF in 2015.

Introduction

Section 316(a) of the Clean Water Act (CWA) authorizes alternate thermal limits (ATL) for the control of the thermal component of a point source discharge so long as the limits will assure the protection of Balanced Indigenous Populations (BIP) of aquatic life. The term "balanced indigenous population," as defined in Environmental Protection Agency regulations, describes a biotic community that is typically characterized by:

1) diversity appropriate to the ecoregion;
2) the capacity to sustain itself through cyclic seasonal changes;
3) the presence of necessary food chain species; and
4) the lack of domination by pollution-tolerant species

Prior to 2001, the Tennessee Valley Authority's (TVA) Kingston Fossil Plant (KIF) was operating under an ATL that had been continued with each permit renewal based on studies conducted in the mid-1970s. In 1999, EPA Region IV began requesting additional data in conjunction with National Pollutant Discharge Elimination System (NPDES) permit renewal applications to verify that BIP was being maintained at TVA's thermal plants with ATLs. The EPA Region IV guidance to the States for conducting 316(a) studies specified that future ATL requests require new data to demonstrate that aquatic communities in the vicinity of the permitee's plant meet the BIP standard. In the Tennessee River system, TVA has used a reservoir Reservoir Ecological Health (REH) monitoring program since 1990 to evaluate ecological conditions in major reservoirs. One of the five indicators used in the REH program to evaluate reservoir health is the Reservoir Fish Assemblage Index (RFAI) methodology. RFAI has been thoroughly tested on TVA and other reservoirs and published in peer-reviewed literature (Jennings et al., 1995; Hickman and McDonough, 1996; McDonough and Hickman, 1999). Fish communities are used to evaluate ecological conditions because of their importance in the aquatic food web and because fish life cycles are long enough to integrate conditions over time. Benthic macroinvertebrate populations are assessed using the Reservoir Macroinvertebrate Benthic Index (RBI) methodology. Because benthic macroinvertebrates are relatively immobile, negative impacts to aquatic ecosystems can be detected earlier in benthic macroinvertebrate

communities than in fish communities. These data are used to supplement RFAI results to provide a more thorough examination of differences in aquatic communities upstream and downstream of thermal discharges.

TVA proposed using data from its existing REH monitoring program, supplemented with fish community monitoring upstream and downstream of power plants with ATLs, to verify the conclusion of the earlier studies that BIP was being maintained. The Tennessee Department of Environment and Conservation agreed with this proposal in a letter dated September 17, 2001.

TVA initiated a study in 2001 to evaluate fish communities in areas immediately upstream and downstream of KIF using RFAI multi-metric evaluation techniques. Beginning in 2011, the EPA requested additional information about the ecological community upstream and downstream of KIF. To meet these requests, TVA broadened the monitoring program to include visual surveys of shoreline wildlife groups. This report presents the results of all biological monitoring and water quality data collected upstream and downstream of KIF during autumn 2015, with appropriate comparisons to data collected at these sites during previous autumn samples.

Plant Description

Kingston Fossil Plant

The KIF facility is located on the right descending bank (RDB) of a peninsula at the confluence of the Emory and Clinch Rivers on Watts Bar Reservoir (Figure 1). Construction of KIF began on April 30, 1951, and the last of nine generation units began commercial operation on December 2, 1955. Total generating capacity is 1,600 megawatts.

The cooling water for KIF's condensers is pumped from the Watts Bar Reservoir pool at Emory River Mile (ERM) 1.9 (Figure 2). At full operating capacity, cooling water flows through the condensers at a rate of 2,154 cubic feet per second (cfs). The condenser cooling water (CCW) discharge point is located across the peninsula at Clinch River Mile (CRM) 2.6 (Figure 2). The average daily flow at this site is approximately 6,200 cfs (based on flow data from 1976 through 2011 at USGS Emory River Gage #03540500 and discharges from TVA's Melton Hill Dam).

Methods

Evaluation of Plant Operating Conditions

Data describing the operation of KIF during the course of biological monitoring—specifically daily averages of power generation, water temperatures at the cooling water system intake and discharge, the intake flow of cooling water and the discharge flow returned to the river—were collected, compiled, analyzed and compared to available historical operational data to assist in the interpretation of thermal plume characteristics and biological community information.

Aquatic Habitat in the Vicinity of KIF

Shoreline and river bottom habitat data presented in this report were collected during autumn 2015. TVA assumes habitat data to be valid for five years, barring any major changes to the river/reservoir (e.g. major flood event). No significant changes have occurred in the river system from the initial characterization, but in the event of a major change to the river/reservoir, habitat would be re-evaluated during the following sample period.

Shoreline Aquatic Habitat Assessment

An integrative multi-metric index (Shoreline Aquatic Habitat Index or SAHI), including several habitat parameters important to resident fish species, was used to measure existing fish habitat quality in the vicinity of KIF. Using the general format developed by Plafkin et al. (1989), seven metrics were established to characterize selected physical habitat attributes important to reservoir resident fish populations which rely heavily on the littoral (shoreline) zone for reproductive success, juvenile development, and adult feeding (Table 1). Habitat Suitability Indices (US Fish and Wildlife Service), along with other sources of information on biology and habitat requirements (Etnier and Starnes 1993), were consulted to develop "reference" criteria or "expected" conditions from a high quality environment for each parameter. Some generalizations were necessary in setting up scoring criteria to cover the various requirements of all species into one index.

When possible, the quality of shoreline aquatic habitat was assessed while traveling parallel to the shoreline in a boat and evaluating the habitat within 10 vertical feet of full pool. Transects were established across the width of Watts Bar reservoir within the fish community sampling

areas upstream and downstream of KIF (Figures 3 and 4). At each transect, near-shore aquatic habitat was assessed along sections of shoreline corresponding to the left descending bank (LDB) and right descending bank (RDB). For each shoreline section (16 upstream and 16 downstream of KIF) percentages of aquatic macrophytes in the littoral areas were estimated, then each section was scored by comparing the observed conditions associated with each individual metric to the "reference" conditions and assigning the metric a corresponding value: "Good"-5; "Fair"-3; or "Poor"-1 (Table 1). The scores for each of the seven metric were summed to obtain the SAHI value for the shoreline section, and this value was assigned a habitat quality descriptor based on trisecting the range of potential SAHI values ("Poor" 7-16, "Fair" 17-26, and "Good" 27-35).

River Bottom Habitat

Along each transect described above, a benthic grab sample was collected with a Ponar sampler at each of 10 points equally spaced from the LDB to the RDB. Substrate material collected with the Ponar was emptied into a screen, and percentage composition of each substrate was estimated to determine existing benthic habitat across the width of the river. Water depths (feet) at each sample location were recorded. If no substrate was collected after multiple Ponar drops, it was assumed that the substrate was bedrock. For example, when the Ponar was pulled shut, collectors could feel substrate consistency. If it shut easily and was not embedded in the substrate on numerous drops within the same location, substrate was recorded as bedrock.

Fish Community Sampling Methods and Data Analysis for Sites Upstream and Downstream of KIF

Thermal discharge from KIF enters Watts Bar Reservoir in the Clinch River at CRM 2.6 (Figure 2). To evaluate the fish community in the vicinity of KIF, two sample sites were selected upstream of the plant, one upstream of the intake at Emory River mile (ERM) 2.5, and one upstream of the confluence of the two rivers at CRM 4.4 (Figure 3). One sample site was selected downstream of the discharge, centered at CRM 1.5 (Figure 4). TVA's REH monitoring program uses four additional sample areas on Watts Bar Reservoir: Forebay, TRM 531.0; Transition, TRM 560.8; Tennessee River Inflow, TRM 601; and Clinch River Inflow, CRM 22.0 (Figure 1).

Fish sampling methods included boat electrofishing and gill netting (Hubert, 1996; Reynolds, 1996). Electrofishing methodology consisted of fifteen electrofishing boat runs near the shoreline, each 300 meters long and approximately 10 minutes in duration. The total near-shore area sampled is approximately 4,500 meters (15,000 feet).

Experimental gill nets (so called because of their use for research as opposed to commercial fishing) were used as an additional gear type to collect fish from deeper habitats not effectively sampled by electrofishing. Each experimental gill net consists of five 6.1-meter panels for a total length of 30.5 meters (100.1 feet). The distinguishing characteristic of experimental gill nets is mesh size that varies between panels. For this application, each net has panels with mesh sizes of 2.5, 5.1, 7.6, 10.2, and 12.7 cm. Experimental gill nets are typically set perpendicular to river flow extending from near-shore toward the main channel of the reservoir. Ten overnight experimental gill net sets were used at each area.

Fish collected were identified by species, counted, and examined for anomalies (such as disease, deformations, parasites or hybridization). The resulting data were analyzed using RFAI methodology.

The RFAI uses 12 fish community metrics from four general categories: Species Richness and Composition; Trophic Composition; Abundance; and Fish Health. Individual species can be utilized for more than one metric, though hybrid species and non-indigenous species are excluded from metrics counting numbers of individual species. Together, these 12 metrics provide a balanced evaluation of fish community integrity. The individual metrics are shown below, grouped by category:

Species Richness and Composition

(1) Total number of species – Greater numbers of species are considered representative of healthier aquatic ecosystems. As conditions degrade, numbers of species at an area decline.

(2) Number of centrarchid species – Sunfish species (excluding black basses) are invertivores and a high diversity of this group is indicative of reduced siltation and suitable sediment quality in littoral areas.

(3) Number of benthic invertivore species – Due to the special dietary requirements of this species group and the limitations of their food source in degraded environments, numbers of benthic invertivore species increase with better environmental quality.

(4) Number of intolerant species – A group made up of species that are particularly intolerant of physical, chemical, and thermal habitat degradation. Higher numbers of intolerant species suggest the presence of fewer environmental stressors.

(5) Percentage of tolerant individuals (excluding young-of-year) – An increased proportion of individuals tolerant of degraded conditions signifies poorer water quality.

(6) Percent dominance by one species – Ecological quality is considered reduced if one species inordinately dominates the resident fish community.

(7) Percentage of non-indigenous species – Based on the assumption that non-indigenous species reduce the quality of resident fish communities.

(8) Number of top carnivore species – Higher diversity of piscivores is indicative of the availability of diverse and plentiful forage species and the presence of suitable habitat.

Trophic Composition

(9) Percent top carnivores -- A measure of the functional aspect of top carnivores which feed on major planktivore populations.

(10) Percent omnivores -- Omnivores are less sensitive to environmental stresses due to their ability to vary their diets. As trophic links are disrupted due to degraded conditions, specialist species such as insectivores decline while opportunistic omnivorous species increase in relative abundance.

Abundance

(11) Average number per run (number of individuals) – Based on the assumption that high quality fish assemblages support large numbers of individuals.

Fish Health

(12) Percent anomalies -- Incidence of diseases, lesions, tumors, external parasites, deformities, blindness, and natural hybridization is noted for all fish collected, with higher incidence indicating less favorable environmental conditions.

RFAI methodology addresses all four attributes or characteristics of a "balanced indigenous population" (BIP) defined by the CWA, as described below:

(1) A biotic community characterized by diversity appropriate to the ecoregion: Diversity is addressed by the metrics in the Species Richness and Composition category, especially metric 1 – "Number of species." Determination of reference conditions based on the transition zones of upper mainstem Tennessee River reservoirs (as described below) ensures appropriate species expectations for the ecoregion.

(2) The capacity for the community to sustain itself through cyclic seasonal change: TVA uses an autumn data collection period for biological indicators, both REH and upstream/downstream monitoring. Autumn monitoring is used to document community condition or health after being subjected to the wide variety of stressors throughout the year.

One of the main benefits of using biological indicators is their ability to integrate stressors through time. Examining the condition or health of a community at the end of the "biological year" (i.e., autumn) provides insights into how well the community has dealt with the stresses through an annual seasonal cycle. Likewise, evaluation of the condition of individuals in the community (in this case, individual fish as reflected in Metric 12) provides insights into how well the community can be expected to withstand stressors through winter. Further, multiple sampling years during the permit renewal cycle add to the evidence of

whether the autumn monitoring approach has correctly demonstrated the ability of the community to sustain itself through repeated seasonal changes.

(3) The presence of necessary food chain species: Integrity of the food chain is measured by the Trophic Composition metrics, with support from the Abundance metric and Species Richness and Composition metrics. A healthy fish community is comprised of species that utilize complex feeding mechanisms extending into multiple levels of the aquatic food web.

Three dominant fish trophic levels exist within upper mainstem reservoirs; insectivores, omnivores, and top carnivores. To determine the presence of necessary food chain species, these three groups should be well represented within the overall fish community. Other fish trophic levels include benthic invertivores, planktivores, herbivores, and parasitic species. Insectivores include most sunfish, minnows, and silversides. Omnivores include gizzard shad, common carp, carpsuckers, buffalo, and channel and blue catfish. Top carnivores include bass, gar, skipjack herring, crappie, flathead catfish, sauger, and walleye. Benthic invertivores include freshwater drum, suckers, and darters. Planktivores include alewife, threadfin shad, and paddlefish. Herbivores include largescale stonerollers. Lampreys in the genus *Ichthyomyzon* are the only parasitic species occurring in Tennessee River reservoirs.

To establish expected proportions of each trophic guild and the expected number of species included in each guild occurring in transition zones in upper mainstem Tennessee River reservoirs (Chickamauga, Watts Bar, and Fort Loudon reservoirs), data collected from 1993 to 2012 from transition zones in upper mainstem reservoirs were analyzed for each reservoir zone (inflow, transition, forebay). Samples collected in the downstream vicinity of thermal discharges were not included in this analysis so that accurate expectations could be calculated with the assumption that these data represent what should occur in upper mainstem Tennessee River reservoirs absent from point source effects (i.e. power plant discharges). Data from 930 electrofishing runs (a total of 279,000 meters of shoreline sampled) and from 620 overnight experimental gill net sets were included in this analysis for transition areas in upper mainstem Tennessee River reservoirs. From these data, the range of proportional values for each trophic level and the range of the number of species included in each trophic level were trisected. These trisections were intended to show less than expected,

expected and above expected values for trophic level proportions and species occurring within each reservoir zone in upper mainstem Tennessee River reservoirs. The data were also averaged and bound by confidence intervals (95%) to further evaluate expectations for proportions of each trophic level and the number of species representing each trophic level (Table 2).

(4) A lack of domination by pollution-tolerant species: Domination by pollution-tolerant species is measured by metrics 3 ("Number of benthic invertivore species"), 4 ("Number of intolerant species"), 5 ("Percent tolerant individuals"), 6 ("Percent dominance by one species"), and 10 ("Percent omnivores").

Scoring categories are based on "expected" fish community characteristics in the absence of human-induced impacts other than impoundment of the reservoir. These categories were developed from historical REH fish assemblage data representative of transition zones from upper mainstream Tennessee River reservoirs (Hickman and McDonough 1996). Attained values for each of the 12 metrics were compared to the scoring criteria and assigned scores to represent relative degrees of degradation: least degraded (5); intermediately degraded (3); and most degraded (1). Scoring criteria for upper mainstem Tennessee River reservoirs are shown in Table 3.

If a metric was calculated as a percentage (e.g., "Percent tolerant individuals"), the data from electrofishing and gill netting were scored separately and allotted half the total score for that individual metric. Individual metric scores for a sampling area (i.e., upstream or downstream) were summed to obtain the RFAI score for the area.

TVA uses RFAI results to determine maintenance of BIP using two approaches. One is "absolute" in that it compares the RFAI scores and individual metrics to predetermined values. The other is "relative" in that it compares RFAI scores attained downstream to the upstream control site. The "absolute" approach is based on Jennings et al. (1995) who suggested that favorable comparisons of the attained RFAI score from the potential impact zone to a predetermined criterion can be used to identify the presence of normal community structure and function, and hence existence of BIP. For multi-metric indices, TVA uses two criteria to ensure

a conservative screening of BIP. First, if an RFAI score reaches 70% of the highest attainable score of 60 (adjusted upward to include sample variability as described below), and second, if fewer than half of RFAI metrics receive a low (1) or moderate (3) score, then community structure and function are considered normal, indicating that BIP had been maintained and no further evaluation would be needed.

RFAI scores range from 12 to 60. Ecological health ratings (12-21 "Very Poor", 22-31 "Poor", 32-40 "Fair", 41-50 "Good", or 51-60 "Excellent") are then applied to scores. As discussed in detail below, the average variation for RFAI scores in TVA reservoirs is 6 (± 3). Therefore, any location that attains a RFAI score of 45 (75% of the highest score) or higher would be considered to have BIP. It must be stressed that scores below this threshold do not necessarily reflect an adversely impacted fish community. The threshold is used to serve as a conservative screening level; i.e., any fish community that meets these criteria is obviously not adversely impacted. RFAI scores below this level would require a more in-depth look to determine if BIP exists. An inspection of individual RFAI metric results and species of fish used in each metric are an initial step to help identify if operation of KIF is a contributing factor. This approach is appropriate because a validated multi-metric index is being used and scoring criteria applicable to the zone of study are available.

A comparison of RFAI scores from the area downstream of KIF to those from the upstream (control) area is one basis for determining if operation of the plant has had any impacts on the resident fish community. The definition of "similar" is integral to accepting the validity of these interpretations. The Quality Assurance (QA) component of the REH monitoring program deals with how well the RFAI scores can be repeated and is accomplished by collecting a second set of samples at 15%-20% of the areas each year. Comparison of paired-sample QA data collected over seven years shows that the difference in RFAI index scores ranges from 0 to 18 points. The mean difference between these 54 paired scores is 4.6 points with 95% confidence limits of 3.4 and 5.8. The 75^{th} percentile of the sample differences is 6, and the 90^{th} percentile is 12. Based on these results, a difference of 6 points or less in the overall RFAI scores is the value selected for defining "similar" scores between upstream and downstream fish communities. That is, if the downstream RFAI score is within 6 points of the upstream score and if there are no major

differences in overall fish community composition, then the two locations are considered similar. It is important to bear in mind that differences greater than 6 points can be expected simply due to method variation (25% of the QA paired sample sets exceeded that value). An examination of the 12 metrics (with emphases on fish species used for each metric) is conducted to analyze any difference in scores and the potential for the difference to be thermally related.

Statistical Analyses

In addition to RFAI analyses, data were analyzed using traditional statistical methods. Data from the survey were used to calculate catch per unit effort (CPUE), expressed as number of fish per electrofishing run or fish per net night. CPUE values were calculated by pollution tolerance, trophic guilds (e.g., benthic invertivores, top carnivores, etc.), thermal sensitivity (Yoder et al. 2006), and indigenous status. CPUE, diversity, and species richness values were computed for each electrofishing effort (to maximize sample size; n = 30) and compared upstream and downstream to assess potential effects of power plant discharges.

Diversity was quantified using two commonly applied indices: Shannon diversity index (Shannon 1948) and Simpson diversity index (Simpson 1949). Both indices account for the number of species present, as well as the relative abundance of each species.

Shannon diversity index values were computed using the formula:

$$H' = -\sum_{i=1}^{S} \left(\frac{n_i}{N}\right) \ln\left(\frac{n_i}{N}\right)$$

where:

S = total number of species

N = total number of individuals

n_i = total number of individuals in the i^{th} species

The Simpson diversity index was calculated as follows:

$$D_S = \left(\sum_{i=1}^{S} \left(\frac{n_i}{N} \right)^2 \right) - 1$$

where:

S = total number of species

N = total number of individuals

n_i = total number of individuals in the i^{th} species

An independent two-sample *t*-test was used to test for differences in CPUE, species richness, and diversity values upstream and downstream of KIF ($\alpha = 0.05$). Before statistical tests were performed using this method, data were analyzed for normality using the Shapiro-Wilk test (Shapiro and Wilk 1965) and homogeneity of variance using Levene's test (Levene 1960). Non-normal data or data with unequal variances were transformed using either square root conversion or the ln(x+1) transformation. Transformed data were reanalyzed for normal distribution and equal variances. If transformation normalized the data or resulted in homogeneous variances, transformed data were tested using an independent two-sample *t*-test. If transformed data were not normally distributed or had unequal variances, statistical analysis was conducted using the Wilcoxon-Mann-Whitney test (Mann and Whitney 1947; Wilcoxon 1945).

Benthic Macroinvertebrate Community Sampling Methods and Data Analysis for Sites Upstream and Downstream of KIF

To assess the benthic macroinvertebrate community around KIF, three transects were established across the width of the Clinch River. One transect was established upstream of the KIF intake at CRM 3.75 (Figure 3) and was used as a control site for comparison to benthic community composition potentially affected by the KIF thermal effluent. One downstream transect was established at CRM 2.2 within the thermal plume, and a second was established at CRM 1.5, just below the downstream extent of the plume (Figure 4). A Ponar sampler (area per sample 0.06 m^2) was used to collect benthic samples at ten points equally spaced along each transect. When heavier substrate was encountered, a Peterson sampler (area per sample 0.11 m^2) was used. Sediments from each sample were washed on a 533µ screen, and organisms were picked from

the screen and from any remaining substrate. Samples were fixed in formalin and sent to an independent consultant who identified each organism collected to the lowest possible taxonomic level.

Benthic samples were evaluated using seven metrics that represent characteristics of the benthic community. Results for each metric were assigned a rating of 1, 3, or 5, based on comparison to reference conditions developed for REH reservoir inflow sample sites (Table 4). For each sample site, the ratings for the seven metrics were then summed to produce an RBI score. Potential RBI scores ranged from 7 to 35. Ecological health ratings derived from the range of potential values (7-12 "Very Poor", 13-18 "Poor", 19-23 "Fair", 24-29 "Good", or 30-35 "Excellent") were then applied to scores. The individual metrics are described below:

(1) Average number of taxa — Calculated by averaging the total number of taxa present in each sample at a site. Greater taxa richness indicates better conditions than lower taxa richness.

(2) Proportion of samples with long-lived organisms — A presence/absence metric that is evaluated based on the proportion of samples with at least one long-lived organism (*Corbicula, Hexagenia*, mussels, or snails) present. The presence of long-lived taxa is indicative of conditions that allow long-term survival.

(3) Average number of EPT taxa — Calculated by averaging the number of *Ephemeroptera* (mayfly), *Plecoptera* (stonefly), and *Trichoptera* (caddis fly) taxa present in each sample at a site. Higher diversity of these taxa indicates good water quality and better habitat conditions.

(4) Percentage of oligochaetes — Calculated by averaging the percentage of oligochaetes in each sample at a site. Oligochaetes are considered tolerant organisms, so a higher proportion indicates poorer water quality.

(5) Percentage as dominant taxa — Used as an evenness indicator, this metric is calculated by selecting the two most abundant taxa in a sample, summing the number of individuals in those two taxa, dividing that sum by the total number of animals in the sample, and

converting to a percentage for that sample. The percentage is then averaged for the 10 samples at each site. Because the most abundant taxa often differ among the 10 samples at a site, this approach allows more discretion to identify imbalances at a site than developing an average for a single dominant taxon for all samples a site. Dominance of one or two taxa indicates poor conditions.

(6) Average density excluding chironomids and oligochaetes — Calculated by first summing the number of organisms – excluding chironomids and oligochaetes – present in each sample and then averaging these densities for the 10 samples at a site. This metric examines the community, excluding taxa which often dominate under adverse conditions. Higher abundance of taxa other than chironomids and oligochaetes indicates good water quality conditions.

(7) Zero-samples: Proportion of samples containing no organisms — For each site, the proportion of samples which have no organisms are present. "Zero-samples" indicate living conditions unsuitable to support aquatic life (i.e. toxicity, unsuitable substrate, etc.). A site with no zero samples was assigned a score of five. Any site with one or more zero samples was assigned a score of one.

A similar or higher benthic index score at the downstream site compared to the upstream sites was used as the basis for determining absence of impact on the benthic macroinvertebrate community related to KIF's thermal discharge. The QA component of REH monitoring compared benthic index scores from 49 paired sample sets collected over seven years. Differences between these paired sets ranged from 0 to 14 points, the 75^{th} percentile was four points, the 90^{th} percentile was six points. The mean difference between these 49 paired scores was 3.1 points with 95% confidence limits of 2.2 and 4.1. Based on these results, a difference of four points or less was the value selected for defining "similar" scores between upstream and downstream benthic communities. That is, if the benthic score at the downstream site is within four points of the upstream score, the communities are considered similar. However, differences greater than four points can be expected simply due to method variation (25% of the QA paired sample sets exceeded that value). Any difference in scores of four points or greater between

communities is examined on a metric-by-metric basis to determine what caused the difference and the potential for the difference to be thermally related.

Visual Encounter Surveys (Wildlife Observations)

Permanent survey sites were established on both the right and left descending banks at one location upstream of the KIF thermal discharge, centered around CRM 3.5 just below the confluence of the Emory and Clinch Rivers (Figure 3), and at a second location downstream of the discharge, centered around CRM 1.8 (Figure 4). Each survey site spanned a distance of 2,100 m along the shoreline, and the beginning and ending points were marked with GPS for relocation.

Surveys were conducted by steadily traversing the site by boat, at approximately 30 m offshore and parallel to the shoreline, and simultaneously recording observations of wildlife. The sampling frame of each survey generally followed the strip or belt transect concept: from the center-line of each transect landward to an area that included the shoreline and riparian zone (i.e., belt width generally averages 60 m where vision is not obscured), all individuals observed were enumerated. Wildlife observed visually or detected audibly was identified to the lowest taxonomic trophic level, and a direct count of individuals observed per trophic level was recorded. If a flock of a species or a mixed flock of a group of species was observed, numbers of individuals present of each species were estimated. Time was recorded at the start and end points of each site to provide a general measure of effort expended. Variation of observation times among sites was primarily due to the difficulty of approaching some wildlife species without inadvertently flushing them from basking or perching sites.

The principal objective of the surveys was to provide a preliminary set of observations to verify that trophic levels of birds, mammals and reptiles were not affected by thermal effects from the KIF discharge. If expected trophic levels were not represented, further investigation will be used to target particular species and/or species groups (guilds) in an attempt to determine the cause.

Watts Bar Reservoir Flow

Daily average discharges recorded from Melton Hill Dam and the USGS stream gage at ERM 18 at Oakdale, TN were summed to describe the amount of water flowing past KIF and were obtained from TVA's River Operations database and USGS website, respectively.

Thermal Plume Characterization

Physical measurements to characterize and map the KIF thermal plume were collected concurrent with biological field sampling. The plume was characterized under representative thermal maxima and seasonally-expected low flow conditions. Measurements were collected during periods of normal operation of KIF, as reasonably practicable, to capture the thermal plume under existing river flow/reservoir elevation conditions. This effort evaluated potential impacts on recreation and water supply uses and allowed general delineation of the "Primary Study Area" – per the EPA (1977) draft guidance defined as the "*entire geographic area bounded annually by the locus of the 2°C above ambient surface isotherms as these isotherms are distributed throughout an annual period*" – ensuring placement of the biological sampling locations within thermally influenced areas.

However, it is important to emphasize that the $\geq$2ºC isopleth boundary is not a bright line; it is dynamic, changing geometrically in response to changes in ambient river flows and temperatures and KIF operations. As such, samples collected outside of, but generally proximate to the Primary Study Area boundary cannot be considered free of thermal influence and thus should not be discounted. Every effort was made to collect biological samples in thermally affected areas as guided by the Primary Study Area definition.

Depth profiles of temperature from the river surface to the bottom were collected at points along transects crossing the plume. One transect was located proximate to the thermal discharge point; subsequent downstream transects were concentrated in the near field area of the plume where the change in plume temperature was expected to be most rapid. The distance between transects in the remainder of the Primary Study Area increased with distance downstream (or away from the discharge point). The farthest downstream transect was just outside of the Primary Study Area. A transect upstream of the discharge, in an area not affected by the thermal plume, was included

for determining ambient temperature conditions. The total number of transects needed to fully characterize and delineate the plume was determined in the field.

Collection of temperature profiles along a given transect began at or near the shoreline from which the discharge originated and continued until the far shore was reached. Measurements across a transect were typically conducted at points 10%, 30%, 50%, 70%, and 90% from the originating shoreline, though the number of measurement points along transects was sometimes increased in proportion to the magnitude of the temperature change across a given transect. The distances between transects, and between measurement points along each transect, depended on the size of the discharge plume.

Temperature data were compiled and analyzed to present the horizontal and vertical dimensions of the KIF thermal plume using spatial analysis techniques to yield plume cross-sections, which can be used to demonstrate the existence of a zone of passage for fish and other aquatic species under and/or around the plume.

Water Quality Parameters at Fish Sampling Sites during RFAI Samples

Water quality conditions were measured using a Hydrolab® that provided readings for water temperature (°C), conductivity (µS/cm), dissolved oxygen (ppm), and pH. Within each of the electrofishing sample reaches upstream and downstream of KIF, transects were established across the river at the most upstream boundary, at mid-reach, and at the most downstream boundary. Along each transect, samples were collected at the RDB, in mid-channel, and at the LDB by recording readings at one- to two-meter intervals along a vertical gradient from just above the bottom of the river to approximately 0.3 meters from the surface.

Water Supply and Recreational Use Support Evaluation

Water temperature data collected as part of the thermal mapping, and collection of supporting water quality information were used to evaluate potential thermal impacts to water supply and recreational uses in the vicinity (within 10 river miles downstream) of KIF. Locations of public water supply intakes and/or established public recreational areas (if any) were determined and

their position(s) were mapped relative to the KIF thermal plume. The existence of any relevant water temperature data collected by the owners of these water supply intake(s) will be determined; and if available, requested to augment the data collected in the field. As necessary (limited or no available owner-supplied temperature data), direct measurements of water temperature may also be conducted specifically at these locations to evaluate potential thermal effects of the KIF discharge.

Results and Discussion

Evaluation of Plant Operating Conditions

Relevant KIF operational data—mean daily temperatures at the CCW intake and discharge, mean daily flow through the CCW system, and mean daily power generation by the fossil units at KIF—were compiled from 2010 through 2015.

During 2015, biological monitoring was conducted upstream and downstream of KIF on October 13, 14, and 15. Daily mean generation on these dates ranged from 163 to 168 MW; mean daily flow through the condenser circulating water (CCW) system ranged from 410 to 458 mgd (634 to 709 cfs); average intake temperatures ranged from 66.0 to 66.7 °F; and average discharge temperatures ranged from 65.4 to 65.7 °F (Figure 5, Table 5).

During 2015, daily mean generation ranged from 0 to 1380 MW and averaged 90% of historic daily means. Daily intake temperatures ranged from 33.3 to 80.5 °F and on average showed no variance from historic daily means; discharge temperatures ranged from 37.9 to 91.2 °F and averaged 96% of historic daily means. Daily flow through the CCW system was, on average 68% of historic daily flows, ranging from 249 to 1357 mgd (385 to 2100 cfs) (Figure 6).

Aquatic Habitat in the Vicinity of KIF

Shoreline Aquatic Habitat Assessment

Of the sixteen shoreline sections assessed upstream, 13 sections (81%) rated "Fair" and three sections (19%) rated "Good." The average rating for sections along both banks was "Fair". No aquatic macrophytes were observed upstream (Table 6).

Downstream, three sections (19%) rated "Good", four sections (25%) rated "Poor", and the remaining nine sections (56%) rated "Fair". The average rating for sections along both banks was "Fair". Aquatic macrophytes were not found along the right bank but were observed in two shoreline sections on the left bank. Average coverage along the left bank was 13% (Table 7).

River Bottom Habitat

Relative locations of all sixteen transects are shown in Figure 7. Figures 8-11 display substrate percentages at each sample point along the eight transects upstream of KIF. Figures 12-15 display substrate percentages at each sample point along the eight transects downstream of KIF.

Twelve substrate types were identified in samples collected along the eight transects upstream of KIF. The two most prevalent types were silt (42.9%) and detritus (22.6%). Mollusk shell (8.9%) and gravel (8.8%) were observed in similar proportions. Samples collected along the eight transects downstream of KIF contained eight substrate types. The two most prevalent were silt (66.9%) and detritus (11.0%). Gravel (7.2%) and mollusk shell (6.9%) were observed in similar proportions (Table 8).

Fish Community

Fish community samples resulted in RFAI scores of 43 ("Good") for the upstream site and 47 ("Good") for the downstream site (Table 9). The difference of four points indicates that the fish communities were similar during autumn 2015.

Below, the two communities are compared in further detail, utilizing each of the four characteristics of a BIP. Discussion of this comparison includes the metrics appropriate for each characteristic.

(1) A biotic community characterized by diversity appropriate to the ecoregion:

Total number of species (highest rating requires >29)

Thirty-three indigenous species were collected upstream, and 36 were collected downstream, earning both the highest score (5) (Table 9). Two indigenous species collected upstream, black redhorse (five specimens) and chestnut lamprey (one specimen), were not found downstream during 2015 (Tables 10 and 11). In records since 2001, black redhorse was collected at the upstream site in every sample and was collected downstream during 2011, 2012, and 2013; chestnut lamprey was collected upstream in only one other sample (2010) and was collected downstream only during 2010 (Table 12). During 2015, five indigenous species collected downstream were not found upstream: white crappie (two specimens), bullhead minnow (seven), quillback (one), black buffalo (one), and snubnose darter (two) (Tables 10 and 11). In records since 2001, white crappie and black buffalo have been collected at both sites during several previous samples; bullhead minnow was previously collected downstream during 2013 and upstream during 2011 and 2007. Quillback has previously been collected downstream during only one other sample (2012) and upstream only during 2003. Snubnose darter has never previously been collected at the downstream site and was only collected upstream during 2001 (Table 12). It is also noted that greenside darter, collected at both sites during 2015, has not been collected previously at either site in records since 2001 (Tables 10, 11, 12).

The non-indigenous species common carp, striped bass, yellow perch, and Mississippi silverside were collected at both sites during 2015. Redbreast sunfish was collected downstream but was not observed upstream (Tables 10 and 11).

Total number of centrarchid species (highest rating requires >4)

Six centrarchid species were collected upstream, and seven species were collected downstream. Both sites received the highest score (5). Black crappie, bluegill, green sunfish, longear sunfish,

redear sunfish, and warmouth were collected at both sites; white crappie was collected only downstream (Table 9).

Total number of benthic invertivore species (highest rating requires >7)

Six benthic invertivore species were collected upstream and five species downstream, producing mid-range scores (3) for both sites. Freshwater drum, golden redhorse, logperch, northern hogsucker, and spotted sucker were collected at both sites, while black redhorse was collected only upstream (Table 9).

Number of intolerant species (highest rating requires > 4)

Both sites received the highest score (5). Eight intolerant species were collected upstream, seven species were collected downstream. Black redhorse was collected only upstream (Table 9).

Percent non-indigenous species (highest rating requires < 3%, electrofishing; < 5%, gill netting)

Both sites earned lowest scores for both portions of the sample. Large collections of Mississippi silverside (21.6% upstream, 12.1% downstream) depressed the scores for the electrofishing collections at both sites. Two other species were collected by electrofishing upstream in smaller proportions [common carp (1.4%), and yellow perch (0.2%)], and four other species were collected downstream in smaller proportions [common carp (0.4%), redbreast sunfish (0.1%), striped bass and yellow perch (<0.1% each)]. Gill net samples at both sites contained two non-indigenous species in similar proportions: striped bass (12.3% upstream, 7.1% downstream), and common carp (1.5% upstream, 2.1% downstream) (Table 9).

Number of top carnivore species (highest rating requires > 7)

Eleven top carnivore species were collected upstream. The same eleven species, plus white crappie, were collected downstream. Both sites earned highest scores (5) (Table 9).

Summary

Both sites received identical scores for the six metrics discussed. Both received highest scores for "Number of indigenous species", "Number of intolerant species", and "Number of top carnivore species", and midrange scores for "Number of centrarchid species" and "Number of benthic invertivore species". Both sites received lowest scores for "Percent non-indigenous species" due to large numbers of Mississippi silverside collected by electrofishing and to large numbers of striped bass collected in gill nets.

(2) The capacity for the community to sustain itself through cyclic seasonal change:

During autumn 2015, sampling generated total RFAI scores of 43 ("Good") for the upstream site and 47 ("Good") for the downstream site. Autumn RFAI sampling has been conducted at the sites upstream and downstream of KIF during odd years since 2001 and additionally during 2010 and 2012. The average score over this period for the upstream site is 42 ("Good") and for the downstream site is 40 ("Fair") (Table 13).

The composition of an autumn sample is often indicative of the ability of the fish community to withstand the stresses of an annual seasonal cycle. During 2015, 36 species were collected upstream, and 33 species were collected downstream. From 2001 through 2015, the number of indigenous species collected upstream has ranged from 27 (2011 and 2012) to 34 (2003) with an average of 30 species. The number collected downstream has ranged from 24 (2007) to 36 (2015) with an average of 31 (Figure 16).

Average number per run (highest rating requires > 210 for electrofishing, > 24 for gill netting)

With an average of 87.8 fish collected per electrofishing run, the upstream site earned the lowest partial score, while the the downstream site earned a midrange partial score with an average of 142.9 fish per run. Both sites earned midrange scores for the gill netting portion of the sample: collections upstream averaged 13.0 fish per net-night; collections downstream averaged 14.1 fish per net-night (Table 9).

Percentage of anomalies (highest rating requires < 2% for electrofishing, 2% for gill netting)

The percentage of anomalies (i.e. visible lesions, bacterial and fungal infections, parasites, muscular and skeletal deformities, and hybridization) in a sample can also be an indicator of the ability of the fish community to sustain itself over an annual seasonal cycle. Both sites received the highest scores for both portions of the collection. Upstream, 0.2% of the electrofishing collection exhibited anomalies; no anomalies were observed in the gill net collection. Downstream, anomalies were observed in 0.2% of the electrofishing collection and 0.7% of the gill net collection (Tables 9).

Summary

During 2015, collections at both the upstream and downstream site exhibited low percentages of anomalies. The total RFAI score and the total number of indigenous species collected were greater downstream than upstream, and electrofishing efforts downstream collected a greater average number of fish per run than those upstream. Calculated over the history of sampling around KIF, the average numbers of indigenous species collected at the two sites were similar. The average RFAI scores over this history were higher for the upstream site than for the downstream site, but the averages differed by only two points, indicating similarity over the long term.

(3) The presence of necessary food chain species:

For each of the sampling sites upstream and downstream of KIF, the proportion of the total sample made up by each trophic guild was estimated from the collection data (Tables 10 and 11). In Table 2, these estimated proportions and the number of species observed within each trophic guild are compared with the expected values for transition zones in upper mainstem Tennessee River reservoirs.

In the community upstream of KIF, proportions of benthic invertivores, insectivores, omnivores and planktivores exceeded expectations while the proportion of top carnivores was poorer than expected. Numbers of benthic invertivore species, insectivore species, and top carnivore species exceeded expectations, and numbers of omnivore and planktivore species were within expected ranges. Additionally, one species of specialized insectivore and one parasitic species were

observed. In the community downstream of KIF, the proportions of benthic invertivores and insectivores were within expected ranges, and the proportion of omnivores was better (lower) than expecations. The proportions of top carnivores and of planktivores were poorer than expected. Two species of specialized insectivores were observed (Table 2).

In direct comparison, the two sites exhibited similar proportions of top carnivores, omnivores, and specialized insectivores, but the upstream site had a higher proportion of benthic invertivores and a much higher proportion of insectivores, due primarily to a large collection of bluegill (540 individuals, 37.3%) that was not matched downstream. One species of planktivore – threadfin shad – was collected in unusually large numbers downstream and dominated the trophic composition (46.1%) of the downstream community. Collections at both sites included similar numbers of species of all the major trophic guilds (Table 2).

Percent top carnivores (highest rating requires >11% for electrofishing, >52% for gill netting)
The upstream site earned midrange scores for both portions of the sample. Seven top carnivore species comprised 10.0% of the electrofishing sample, largemouth bass (8.5%) being most prevalent. Ten top carnivore species comprised 48.5% of the gill net sample, walleye (16.9%) and striped bass (12.3%) being most prevalent. At the downstream site, seven species comprised 6.3% of the electrofishing catch, generating a midrange score. Largemouth bass was most prevalent, making up 5.6% of the total. Twelve species comprised 61.7% of the gill net catch, generating the highest score. White bass (21.3%) and skipjack herring (15.6%) were the most prevalent species; striped bass and walleye each comprised 7.1% of the total (Table 9).

Percent omnivores (highest rating requires < 22%)
Both sites earned highest scores for the electrofishing portion of the sample. Six omnivore species were collected by electrofishing at each site, comprising 4.4% of the upstream sample and 9.0% of the downstream sample. Both sites earned midrange scores for the gill net catch: five species of omnivore were collected upstream, making up 36.2% of the gill net sample; six species were collected downstream, making up 29.8% of the sample (Table 9).

Summary

Collections at both sites included similar numbers of species representing each trophic guild. However, insectivores were notably more abundant upstream, while the downstream site was dominated by planktivores due to a large collection of threadfin shad. The downstream site earned a slightly higher score than upstream for "Percent top carnivores", but both sites earned identical scores for "Percent omnivores".

(4) A lack of domination by pollution-tolerant species:

Number of benthic invertivore species (highest rating requires > 7)

Six benthic invertivore species were collected upstream and five species downstream. Both sites received mid-range scores (3) (Table 9).

Number of intolerant species (highest rating requires > 4)

Both sites received the highest score (5). Eight intolerant species were collected upstream; seven species were collected downstream (Table 9).

Percentage of tolerant individuals (highest rating requires <31% for electrofishing; <16% for gill netting)

The upsteam site earned midrange scores for both portions of the sample. Tolerant individuals of seven species made up 58.9% of the electrofishing sample, and four species comprised 17.7% of the gill net sample. The downstream site earned highest scores for both portions of the sample. Nine tolerant species comprised 29.9% of the electrofishing catch, and four species comprised 10.6% of the gill net catch. Bluegill was most prevalent tolerant species collected by electrofishing at both sites, constituting 40.9% of the upstream sample and 12.3% of the downstream sample. Gizzard shad was most prevalent in gill net samples at both sites, constituting 13.8% of the catch upstream and 6.4% of that downstream (Table 9).

Percent dominance by one species (highest rating requires <20% for electrofishing; <14% for gill netting)

Both sites earned the lowest score for the electrofishing portion and midrange scores for the gill net portion of the sample. Bluegill comprised 40.9% of the electrofishing sample upstream, and threadfin shad made up 49.1% of the sample downstream. Walleye comprised 16.9% of the gill net sample upstream, and white bass comprised 21.3% of the sample downstream (Table 9).

Percentage of omnivores (highest rating requires <22% for electrofishing; <23% for gill netting)

Both sites earned highest scores for the electrofishing portion and midrange scores for the gill net portion of the sample. Omnivores comprised 4.4% of the electrofishing catch and 36.2% of the gill net catch upstream; omnivores comprised 9.0% of the electrofishing catch and 29.8% of the gill net catch downstream (Table 9).

Summary

Both sites earned identical scores for four of the five metrics discussed. Both exhibited moderate numbers of benthic invertivore species, high diversity of intolerant species, moderate dominance by single species and moderate proportions of omnivores. The upstream site exhibited a higher proportion of tolerant individuals than that downstream.

Statistical Analyses of Electrofishing Samples

Neither the Simpson nor the Shannon index indicated significant difference in fish community diversity between the upstream and downstream sites (Table 14).

Potential differences in species richness between the two communities were also analyzed by parsing the data into nine species parameters. Statistical tests of these parameters indicated that significantly more benthic invertivore species and more thermally sensitive species were collected per run upstream, and that more insectivore species were collected per run downstream. The same nine parameters were also tested for differences in abundance (numbers of individuals per run, or CPUE), and results indicated that more individual benthic invertivores were collected per run upstream (Table 14).

Fish Community Summary

Resident important species (RIS) are defined in EPA guidance as those species which are representative in terms of their biological requirements of a balanced, indigenous community of fish, shellfish, and wildlife in the body of water into which the discharge is made (EPA and NRC, 1977). RIS often include non-indigenous species. Thirty-eight RIS were collected at the site upstream of KIF; 41 were collected at the downstream site (Tables 10 and 11).

Species that experience avoidance behavior or mortality at water temperatures equal to or greater than 32.2°C (90°F) are designated as "thermally sensitive" (Yoder et al., 2006). Two thermally sensitive species, greenside darter and logperch, were collected at both sites (Tables 10 and 11). The aquatic nuisance (non-indigenous) species common carp, striped bass, yellow perch, and Mississippi silverside were collected at both sites. One additional aquatic nuisance species, redbreast sunfish, was collected only downstream. Commercially valuable species are defined as those that may be harvested and sold commercially for food or bait in Tennessee (TWRA, 2012). Recreationally valuable species are those that are targeted by anglers or are used as bait. Among the RIS collected upstream were 14 commercially valuable species and 23 recreationally valuable species, compared to 16 commercially valuable and 23 recreationally valuable species downstream (Tables 10 and 11).

Total RFAI scores for the sampling sites upstream and downstream of KIF differed by four points during 2015, indicating that the two sites exhibited similar ecological structure and balance. As previously discussed, RFAI scores have an intrinsic variability of ± 3 points. This variability comes from several sources, including annual variations in air temperature and stream flow; variations in pollutant loadings from nonpoint sources; changes in habitat, such as extent and density of aquatic vegetation; natural population cycles and movements of the species being measured (TWRC, 2006). Another source of variability arises from the fact that nearly any practical measurement, lethal or non-lethal, of a biological community is a sample rather than a measurement of the entire population.

The effects of these sources of variability could generate a difference in scores due simply to method variation. Accordingly, a thorough comparison of the fish communities upstream and

downstream of KIF was conducted by examining each of the twelve individual RFAI metrics as a component of the appropriate characteristic of a BIP.

Measures of diversity were similar for both communities: both exhibited high diversity of indigenous species, intolerant species, and top carnivore species; both exhibited moderate diversity of centrarchid and benthic invertivore species; and both communities had high proportions of non-indigenous species, primarily Mississippi silverside and striped bass. Both communities were relatively free of anomalies and showed similar sustainability over annual cycles, but trophic composition of the two sites differed: the upstream site included a greater proportion of insectivores than that downstream, due primarily to a large collection of bluegill, while the downstream site was dominated by planktivores (threadfin shad). Both sites exhibited relatively low dominance by pollution tolerant species, though the upstream site included a higher proportion of tolerant individuals than the downstream site.

Statistical tests indicated that the two communities were similar in total diversity, but that the upstream site showed greater species richness of thermally sensitive species, and greater richness and abundance of benthic invertivore species. The downstream site showed greater richness of insectivore species.

It is therefore concluded that the fish community downstream of the KIF discharge was similar in ecological structure and balance to the control community upstream of the intake, and that the downstream community was not adversely affected by operation of KIF during 2015.

To provide additional information about the health of the fish community throughout Watts Bar reservoir, Table 13 compares RFAI scores for the sites upstream and downstream of KIF with those from additional REH sites in the reservoir. For all the REH sites, scores averaged over the duration of sampling are rated as “Good”. It is noted, however, that the aquatic communities at these sites are not subject to thermal effects from KIF and are not used in determination of BIP in relation to KIF.

Benthic Macroinvertebrate Community

As mentioned previously, to assess the condition of the benthic macroinvertebrate community around KIF, sampling was conducted at three sites in autumn 2015. RBI metrics for all three sites were scored using evaluation criteria for lab-processed samples collected in the transition zone (Table 4). Both downstream locations, just downstream of the lower boundary of the thermal plume at CRM 1.5 and within the thermal plume at CRM 2.2, produced RBI total scores of 33 ("Excellent"). Data from control site CRM 3.75, upstream of the facility, produced an overall RBI score of 31 ("Excellent") (Table 15).

A difference of 4 points or less was used to define "similar" conditions between the three sites. Because the RBI scores for the two downstream sites were within 4 points of the RBI score for the upstream control site, conditions among the three sites were considered "similar", supporting the conclusion that the two downstream sites were not adversely affected by the thermal effluent from KIF in 2015.

Results for the autumn 2015 benthic macroinvertebrate sampling can be found in Tables 15 and 16. Autumn 2015 results were compared between the downstream (CRM's 1.5 and 2.2) and upstream (CRM 3.75) sites and are briefly discussed below for each RBI metric.

Average number of taxa (> 6.6 required for highest score)

In autumn 2015, averages of 14 and 14.6 taxa were observed for sites downstream of KIF. The control site upstream of KIF averaged 16.6 taxa per sample. All three sites received the highest score of 5 for this metric (Table 15).

Proportion of samples with long-lived organisms (> 0.9 required for highest score)

The metric "proportion of samples with long-lived organisms" received the highest score of 5 at both downstream sites with 100% containing long-lived organisms (proportion of 1.0). The proportion of samples with long-lived organisms was 100% at the upstream site which also received the highest score for the metric (Table 15).

Average number of EPT taxa (> 1.4 required for highest score)

An average of 1.4 EPT taxa was collected at CRM 1.5, just downstream of the lower boundary of the thermal plume, and upstream of KIF at CRM 3.75, an average of 1.0 EPT taxa was collected. Both sites received the mid-range score of 3. Within the plume at CRM 2.2, an average of 1.5 EPT taxa was collected resulting in the highest score (Table 15).

Average proportion of oligochaete individuals (< 11.0 % required for highest score)

Oligochaetes are considered tolerant organisms; therefore, a lower proportion of oligochaetes may be indicative of better water quality. The site just downstream of the lower boundary of the thermal plume, CRM 1.5, had an average of 7.5% oligochaetes and received the highest score. The site within the plume, CRM 2.2, and the upstream control site, CRM 3.75, had slightly higher proportions of oligochaetes, 11.3% and 11% respectively, resulting in the mid-range score for both sites (Table 15).

Proportion of total abundance comprised by two most abundant taxa (< 77.8 % required for highest score)

The two dominant taxa made up 72.5% and 72.8% of the samples at the downstream sites, CRM 1.5 and TRM 2.2 respectively. Total abundance of the two dominant taxa was considered similar at the upstream control site and made up 66.3% of the samples. All three sites received the highest score (Table 15). Burrowing mayflies, *Hexagenia* sp., and Sphaeriid clams, *Musculium transversum*, were most abundant at CRMs 1.5 and 3.75. Burrowing mayflies (*Hexagenia* sp.) and unspecified Tubificinae worms were most abundant at CRM 2.2 (Table 16).

Average density excluding chironomids and oligochaetes (> 609.9/m^2 required for highest score)

At the downstream sites, average densities excluding chironomids and oligochaetes were 1495/m² and 1373.3/m². Both sites received the highest score. Average density (exclusive of chironomids and oligochaetes) at the upstream control site was 1681.7/m², also resulting in the highest score (Table 15).

Proportion of samples containing no organisms (0 required for highest score)

In autumn 2015, there were no samples at any site which were void of organisms. All three sites received the highest score (Table 15).

Benthic Macroinvertebrate Community Summary

Monitoring results for autumn 2015 support the conclusion that a BIP of benthic macroinvertebrates was maintained downstream of KIF. The site just downstream of the lower boundary of the thermal plume, CRM 1.5, and the site within the plume, CRM 2.2, both received RBI total scores of 33. The upstream control site, CRM 3.75, received an RBI total score of 31. RBI total scores for all three sites rated "Excellent" (Table 15).

Because the RBI total scores for the two downstream sites were within 4 points of the RBI total score for the upstream control site, conditions among the three sites were considered "similar", supporting the conclusion that the two downstream sites were not adversely affected by the thermal effluent from KIF in 2015.

Visual Encounter Survey (Wildlife Observations)

During autumn 2015, observations of shoreline wildlife upstream of KIF included 116 birds of 18 species, 14 turtles of two species, and seven mammals of two species. Observations downstream included 279 birds of 17 species and one mammal. Eleven species of birds (American crow, American robin, blue jay, Canada goose, cardinal, Carolina chickadee, double-crested cormorant, European starling, great blue heron, mockingbird, red-headed woodpecker), one species of turtle (map turtle), and one species of mammal (Eastern grey squirrel) were observed at both stations. Six bird species (mallard, pied-billed grebe, wood duck, Carolina wren, yellow-shafted flicker, and ring-billed gull) two turtle species (common slider and painted turtle), and white-tailed deer were observed only upstream. Seven bird species (American coot, cliff swallow, common grackle, rock dove, turkey vulture, downy woodpecker, and Eastern phoebe) and red-eared turtle were observed only downstream (Table 17).

Table 18 compares the wildlife species observed during autumn surveys conducted along the same transects since 2011. Some species – American crow, Carolina chickadee, double-crested

cormorant, great blue heron, mallard, and map turtle, for example – were observed both upstream and downstream during most years and can be considered common. Others were observed intermittently, along a single transect or during only one sample year. It is important to note that a Visual Encounter Survey provides a preliminary near shore wildlife assessment to determine if the thermally affected area downstream of a power plant has adversely affected the bird, reptile, or mammal communities. Using the methods described for these surveys, determination of the presence and diversity of small, perching bird species, reptiles and mammals is made difficult by their typical behaviors. Other factors contributing to the limited observations of some taxa include ecological status (e.g. top-level predators – raptors such as red-tailed hawk, osprey, bald eagle, etc. – are less abundant than species at lower trophic levels), and migratory habits. The diversity of bird groups recorded indicates that a healthy ecological community has existed both upstream and downstream of KIF since 2011 and that the shoreline wildlife community downstream has not been adversely affected by operation of the plant. If, after any survey an adverse environmental impact is suspected, sampling strategies of a more quantitative nature, such as trapping or netting, active search, investigation of mammal tracks along shoreline areas, long-term observation from blinds, or the use of cameras will be proposed to more accurately estimate the presence and diversity of these groups.

Watts Bar Reservoir Flow near KIF

The sums of average daily flows from Melton Hill Dam and the USGS stream gage at Emory River Mile (ERM 18) at Oakdale, TN during 2015 are shown in Figure 17. Average daily flows during 2015 were similar to historical mean flows during September and October; flows were generally lower than historical flows during February, May, June, and November and were higher than historical flows during the remaining months.

Thermal Plume Characterization

Temperature profiles collected during a previous 316(a) demonstration study (TVA, 1978) indicated the KIF thermal plume rarely extended downstream of CRM 1.4. This is a result of the plant's selective withdrawal of cold water from the Clinch River. Cold water from Norris Reservoir upstream, which flows under the warmer Emory River at their confluence, is diverted toward the intake channel by a submerged dam near CRM 3.9, which is about 0.5 mile

downstream of the mouth of the Emory River. As a result, during summer months the thermal effluent of the KIF plant is approximately the same temperature as the surface waters in the vicinity of the discharge (TVA, 1975).

During the 2015 sampling event, water temperatures were similar at all transects from the confluence to CRM 1.5 downstream of the discharge, with no plume temperatures detected. Highest temperatures were recorded at the surface at all transects (Table 19).

Water Quality Parameters at Fish Sampling Sites during RFAI Samples

In depth profiles collected within the upstream reach on the Clinch River, temperatures ranged from 64.3 to 69.6 °F, pH values ranged from 7.1 to 8.0, conductivity ranged from 217.5 to 264.3 µS/cm, and dissolved oxygen concentration (DO) ranged from 8.4 to 11.2 mg/L (Table 20).

For profiles collected in the downstream sample reach, temperatures ranged from 65.2 °F to 71.0 °F, and surface temperatures of all profiles fell between 70.5 and 71.0 °F. Acidity ranged from pH 7.1 to 7.8. Conductivity ranged from 173.8 to 280.8 µS/cm. The highest conductivity values, observed at the upstream and midreach transects, were similar to those of the upstream profiles. Lowest conductivity values were observed at the downstream boundary transect. DO concentrations ranged from 7.2 to 10.0 mg/L, with the lowest values occurring at the downstream boundary transect (Table 20).

Summary

Generally, values of the water quality parameters for all profiles collected were within expected seasonal ranges and were similar upstream and downstream. In the downstream profiles, slight elevation of surface water temperatures from the KIF thermal effluent is evident, but conductivity values indicate that a zone of passage for fish and other aquatic wildlife exists around the KIF discharge.

Water Supply and Recreational Use Support Evaluation

We are not aware of any domestic water supply intakes located within approximately 10 river miles downstream of the KIF thermal discharge (TDEC 2015, pers. comm.).

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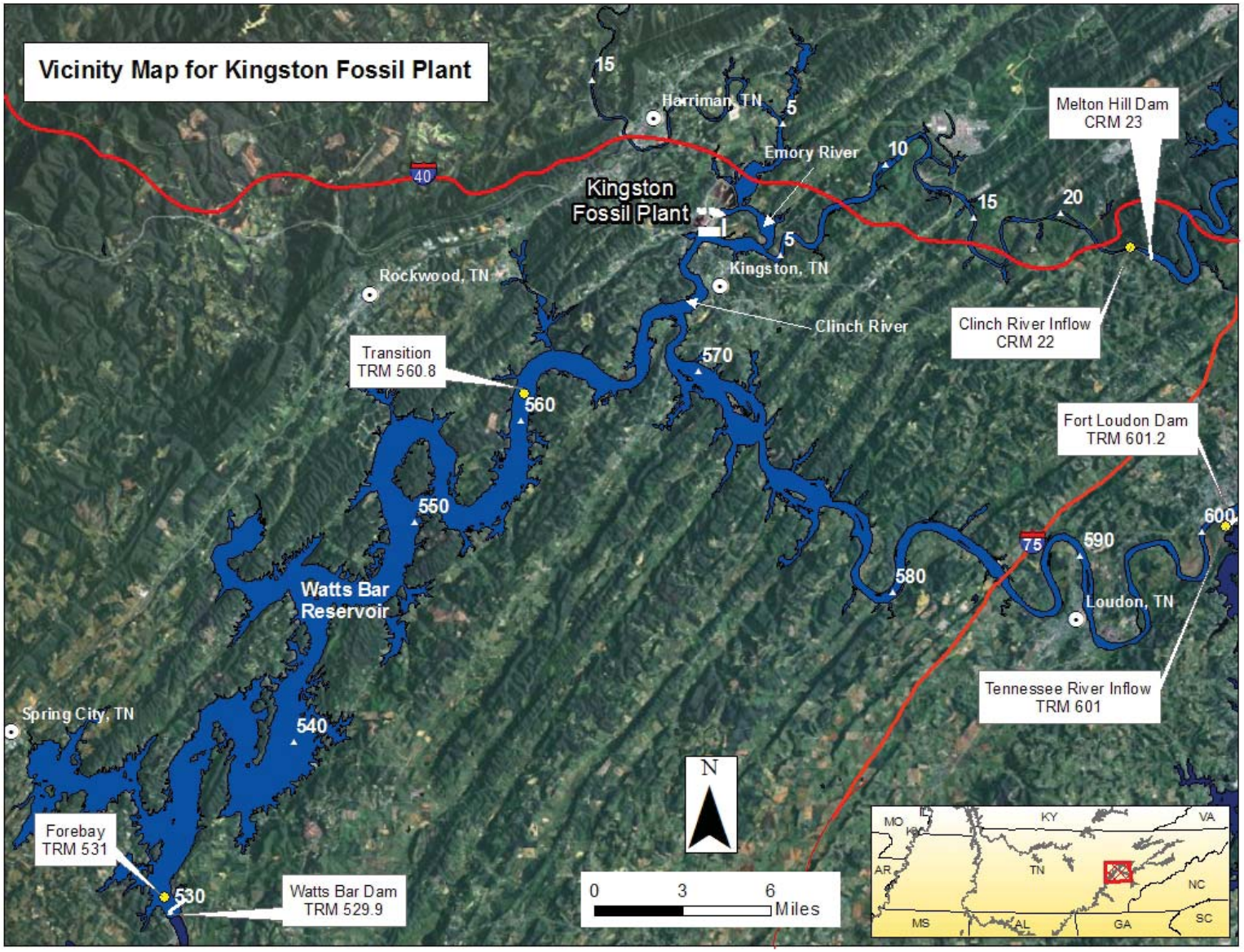

Figure 1. Location of Kingston Fossil Plant on Watts Bar Reservoir at the confluence of the Emory and Clinch Rivers, showing relative locations of Reservoir Ecological Health (REH) Program monitoring sites

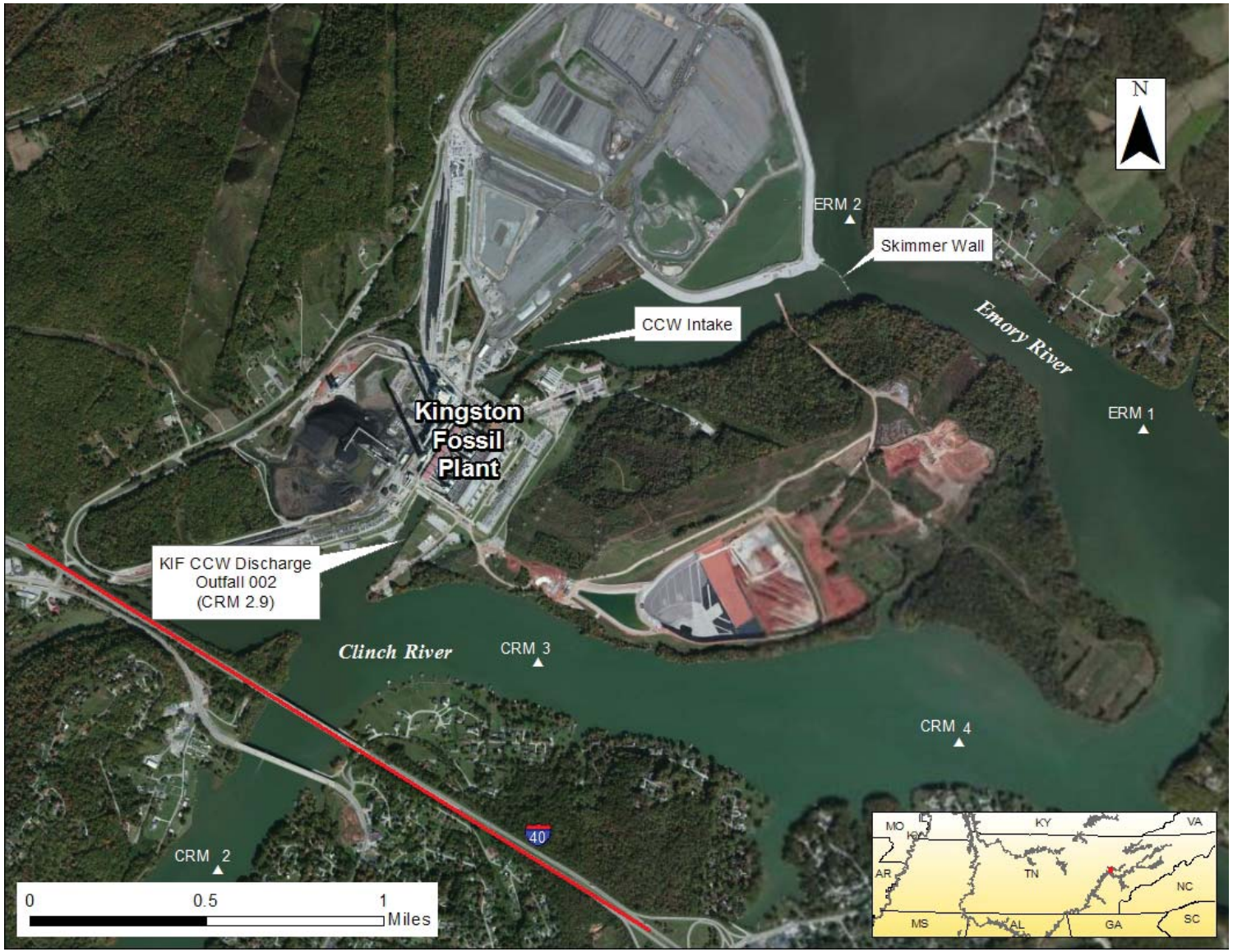

Figure 2. Site map for Kingston Fossil Plant, showing skimmer wall and condenser cooling water (CCW) intake and discharge (Outfall 002)

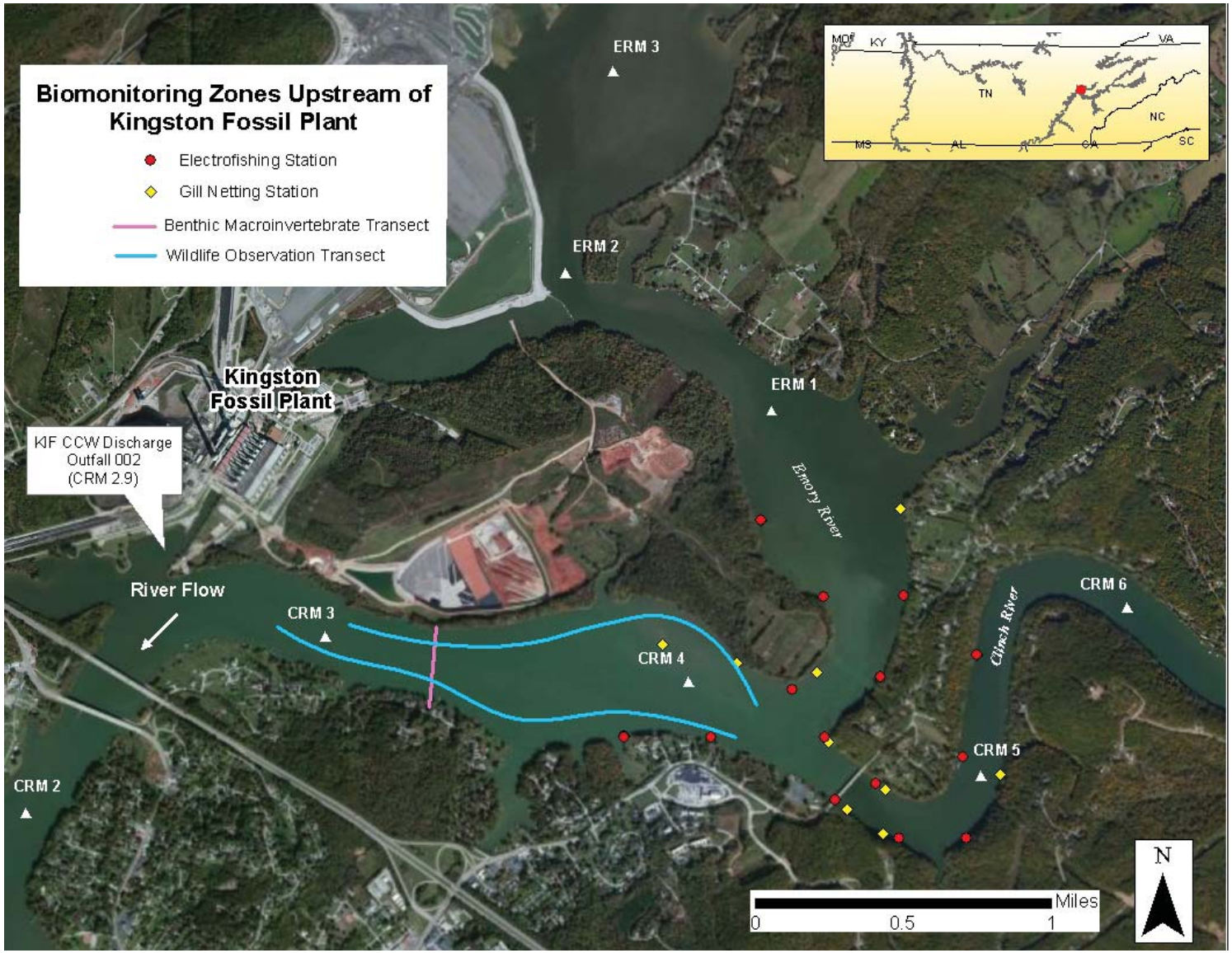

Figure 3. Biological monitoring zones upstream of Kingston Fossil Plant

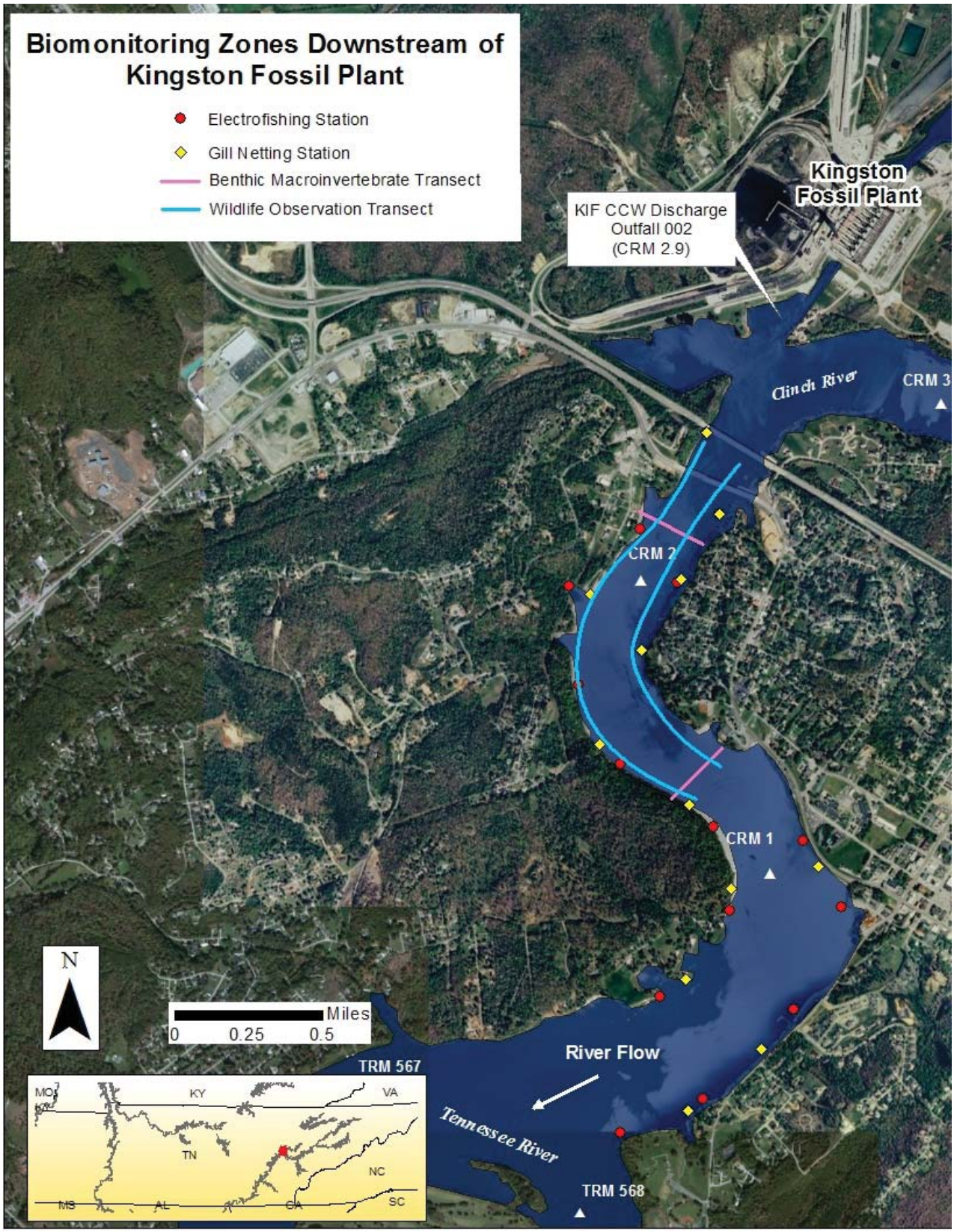

Figure 4. Biological monitoring zones downstream of Kingston Fossil Plant

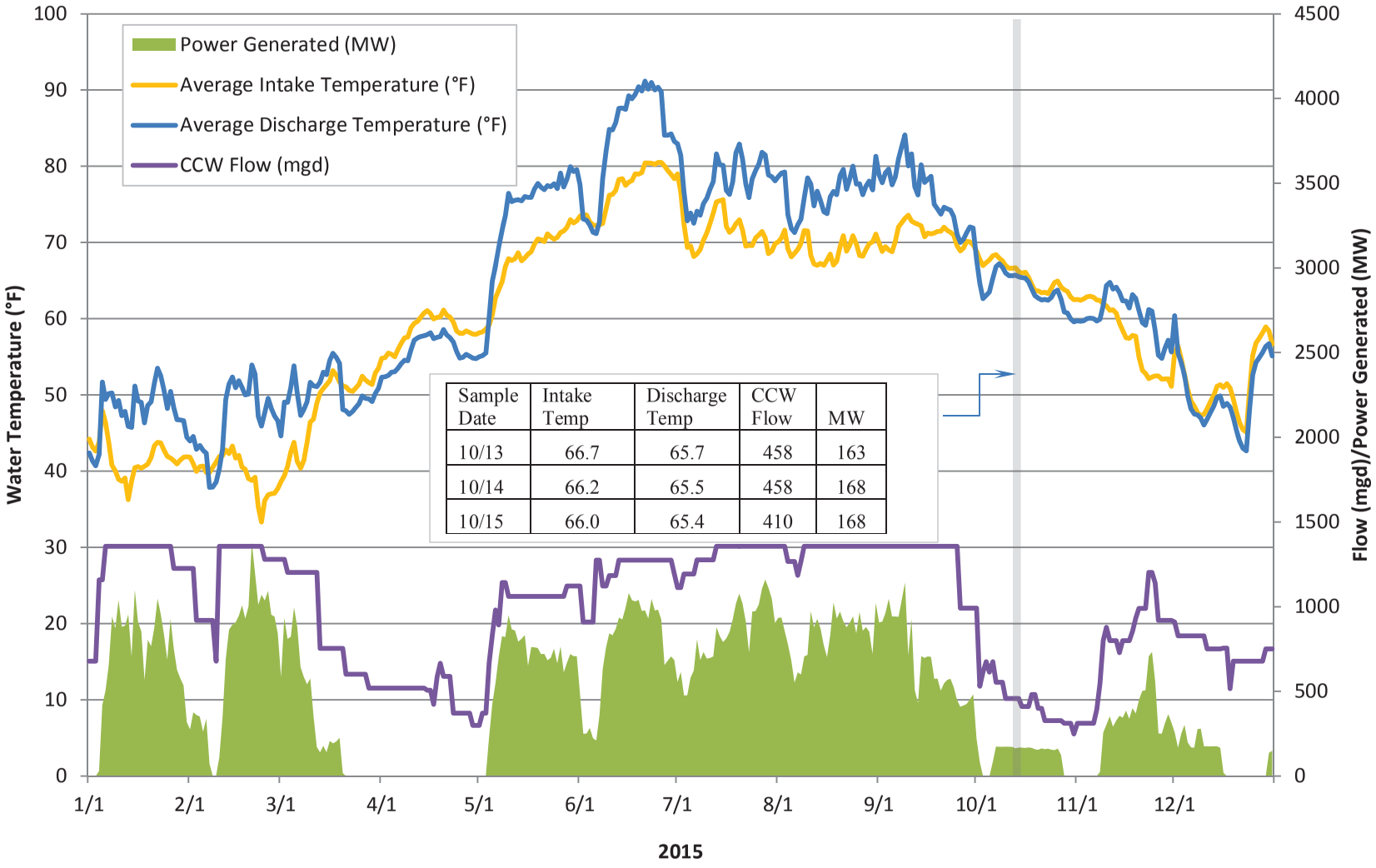

Figure 5. Daily average intake and discharge temperatures and flow through the condenser cooling water (CCW) system, and daily average power generated by Kingston Fossil Plant during 2015

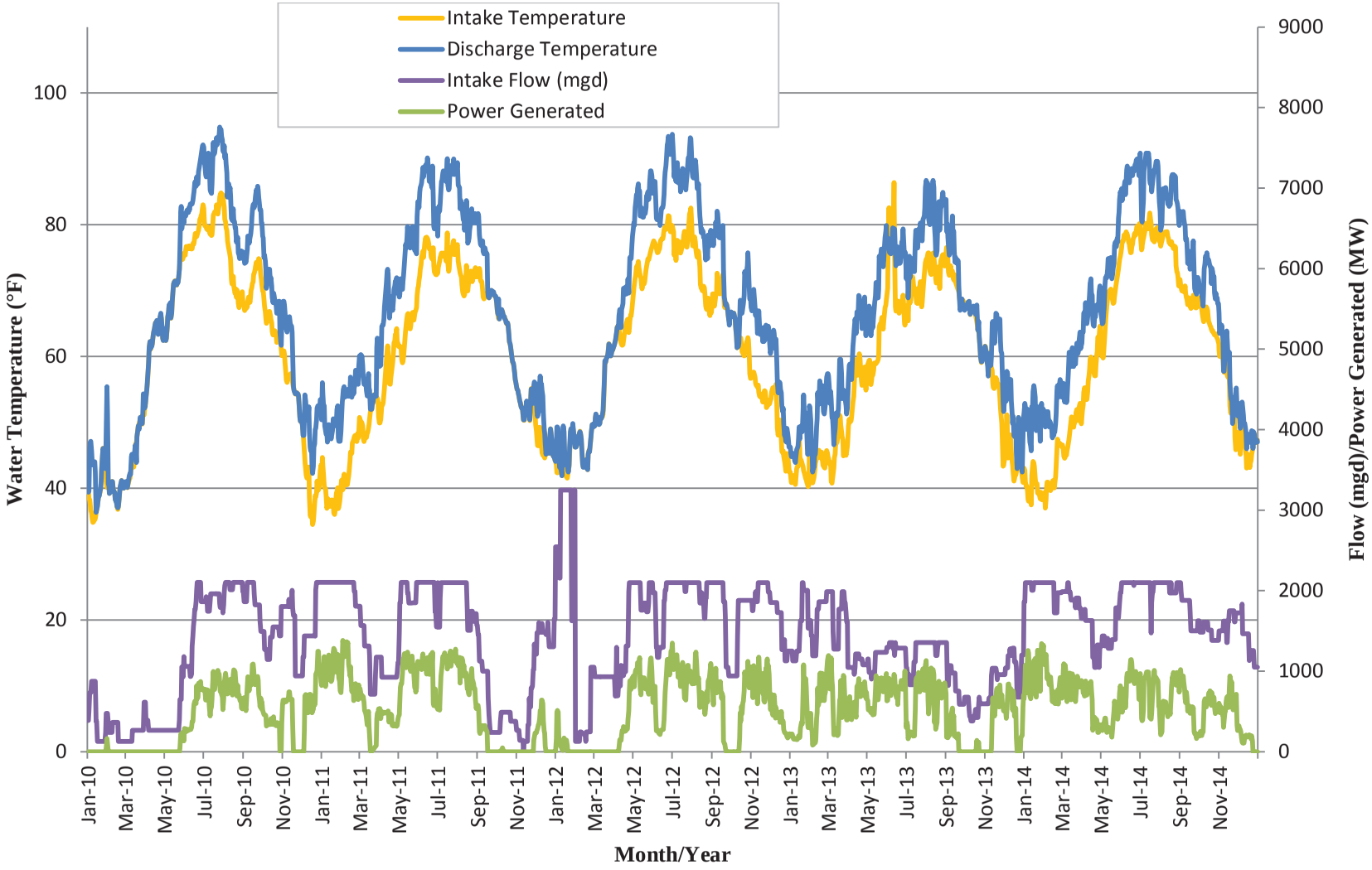

Figure 6. Daily average intake and discharge temperatures and flow through the condenser cooling water (CCW) system, and daily average power generated by Kingston Fossil Plant from 2010 through 2014

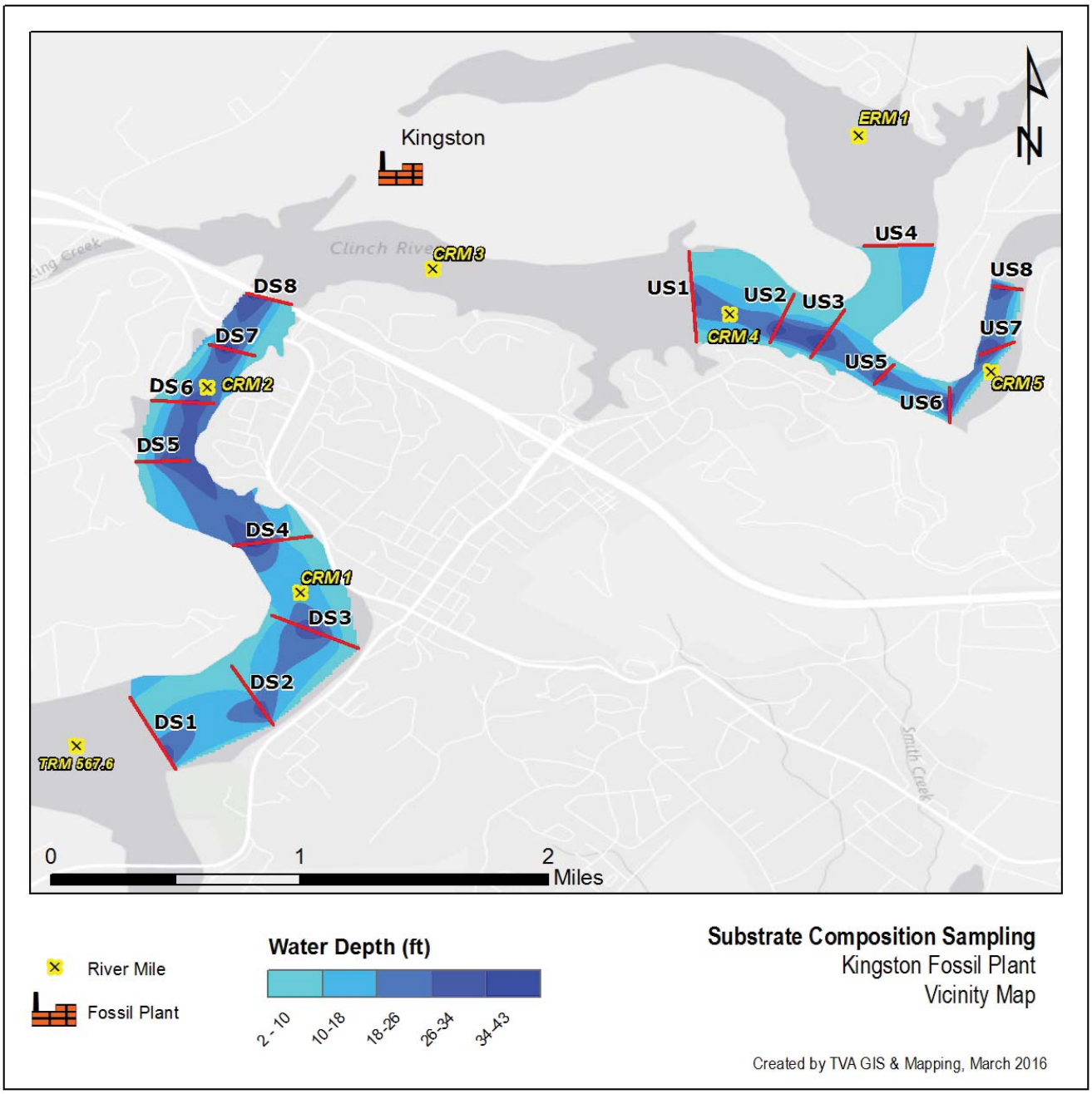

Figure 7. Locations of transects used to characterize shoreline and river bottom habitat upstream and downstream of Kingston Fossil Plant, and water depths within the two sample reaches

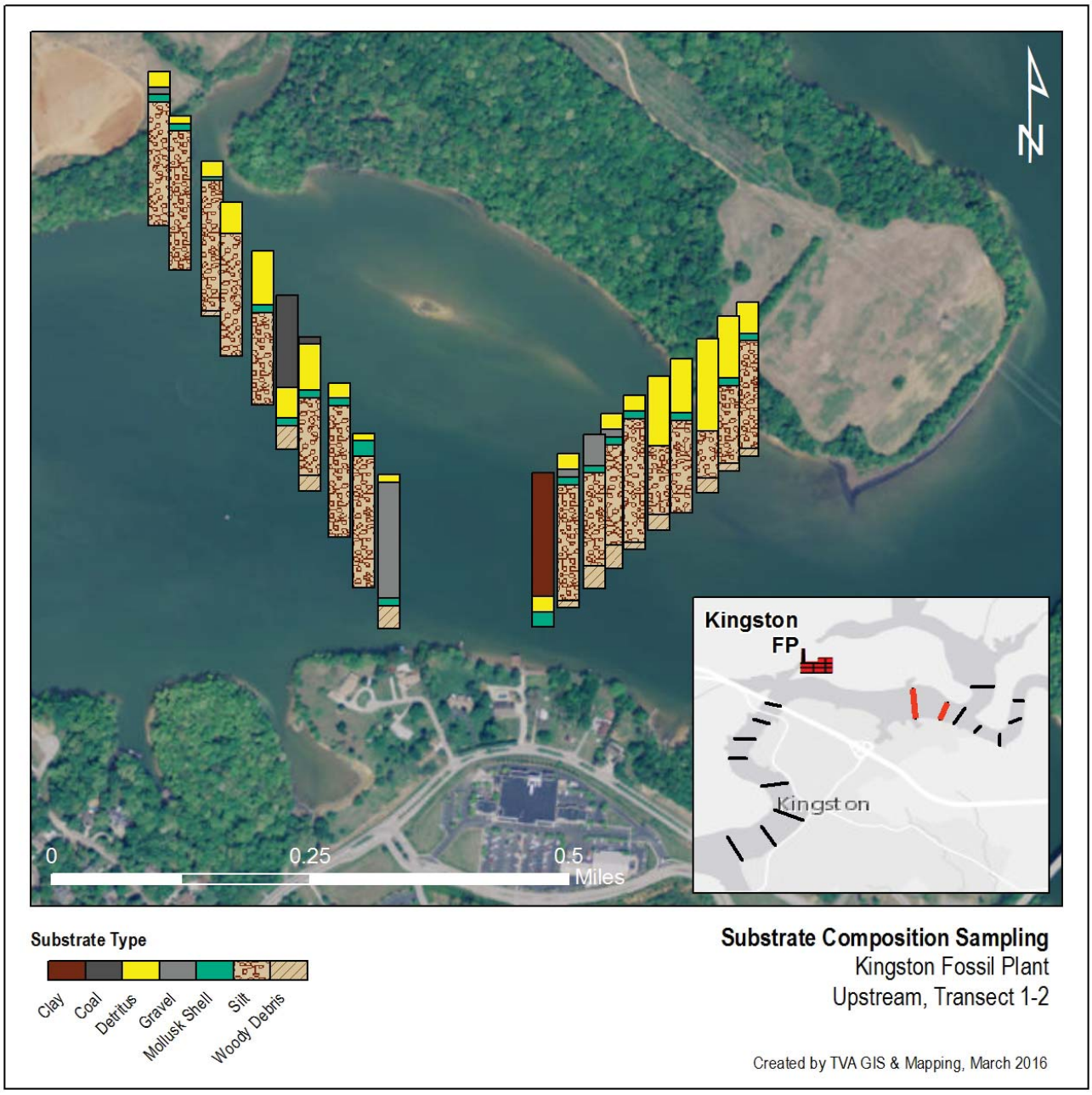

Figure 8. Composition of substrate samples collected at ten points equally spaced along each of transects 1 and 2 upstream of Kingston Fossil Plant

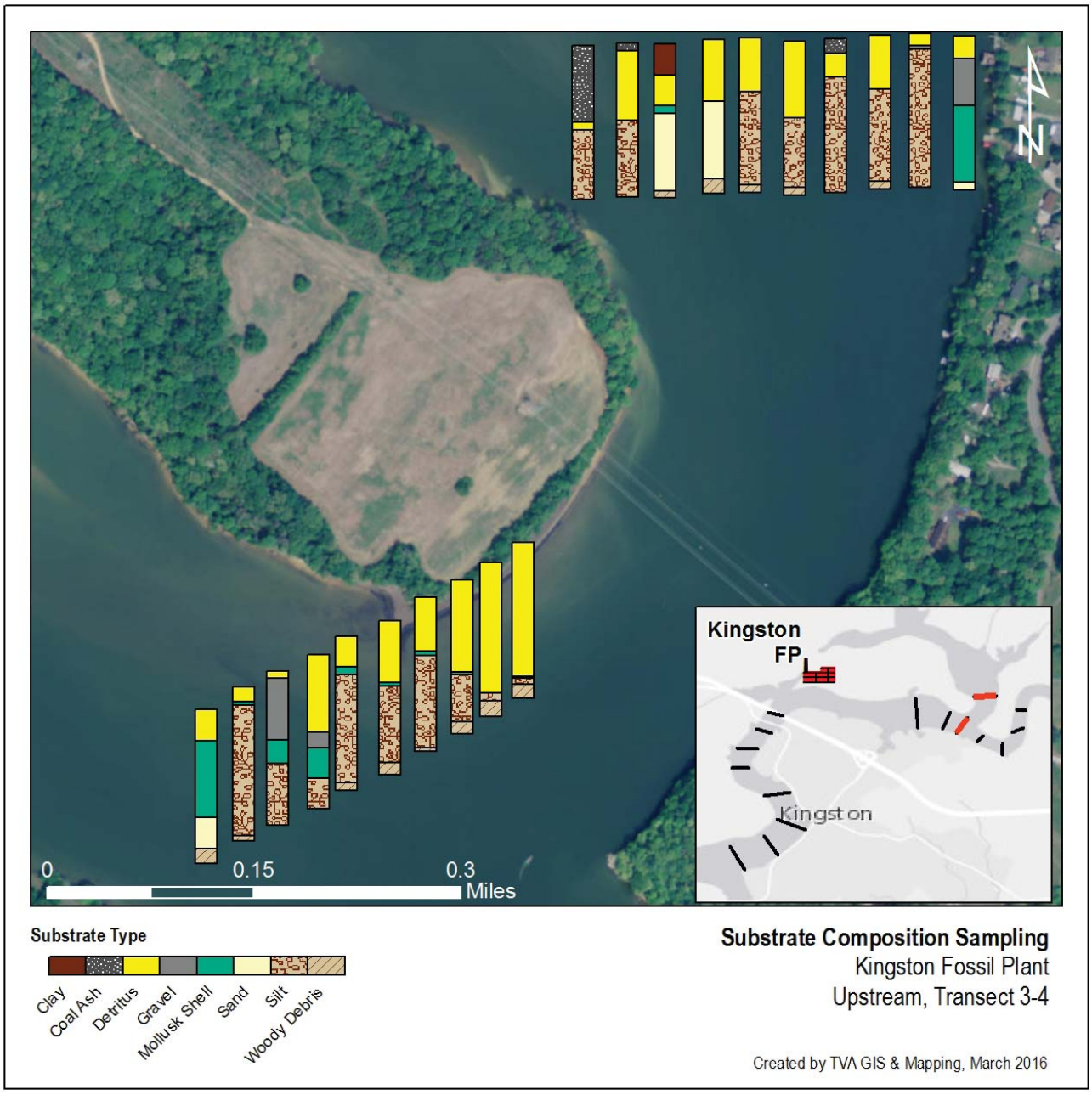

Figure 9. Composition of substrate samples collected at ten points equally spaced along each of transects 3 and 4 upstream of Kingston Fossil Plant

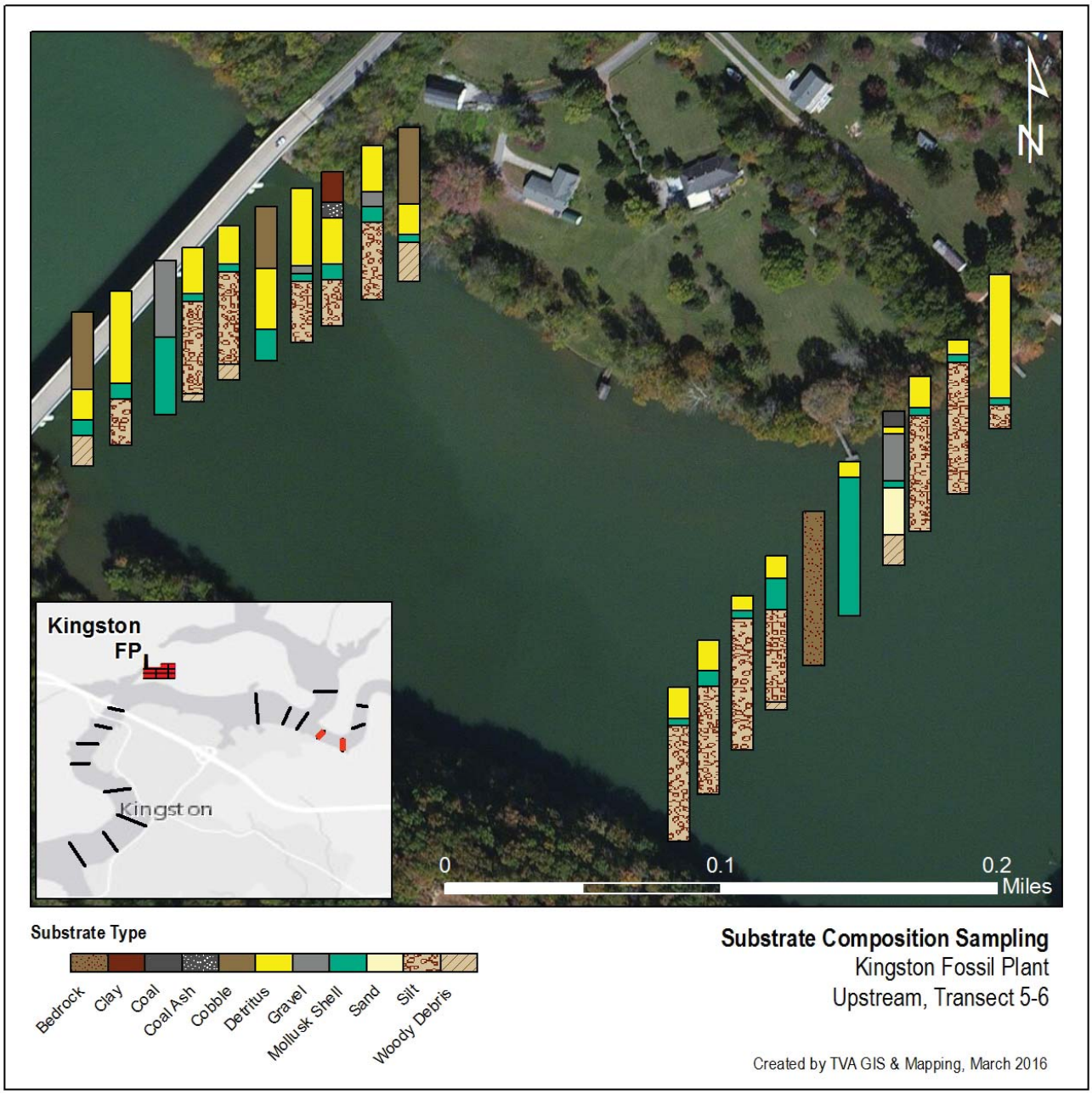

Figure 10. Composition of substrate samples collected at ten points equally spaced along each of transects 5 and 6 upstream of Kingston Fossil Plant

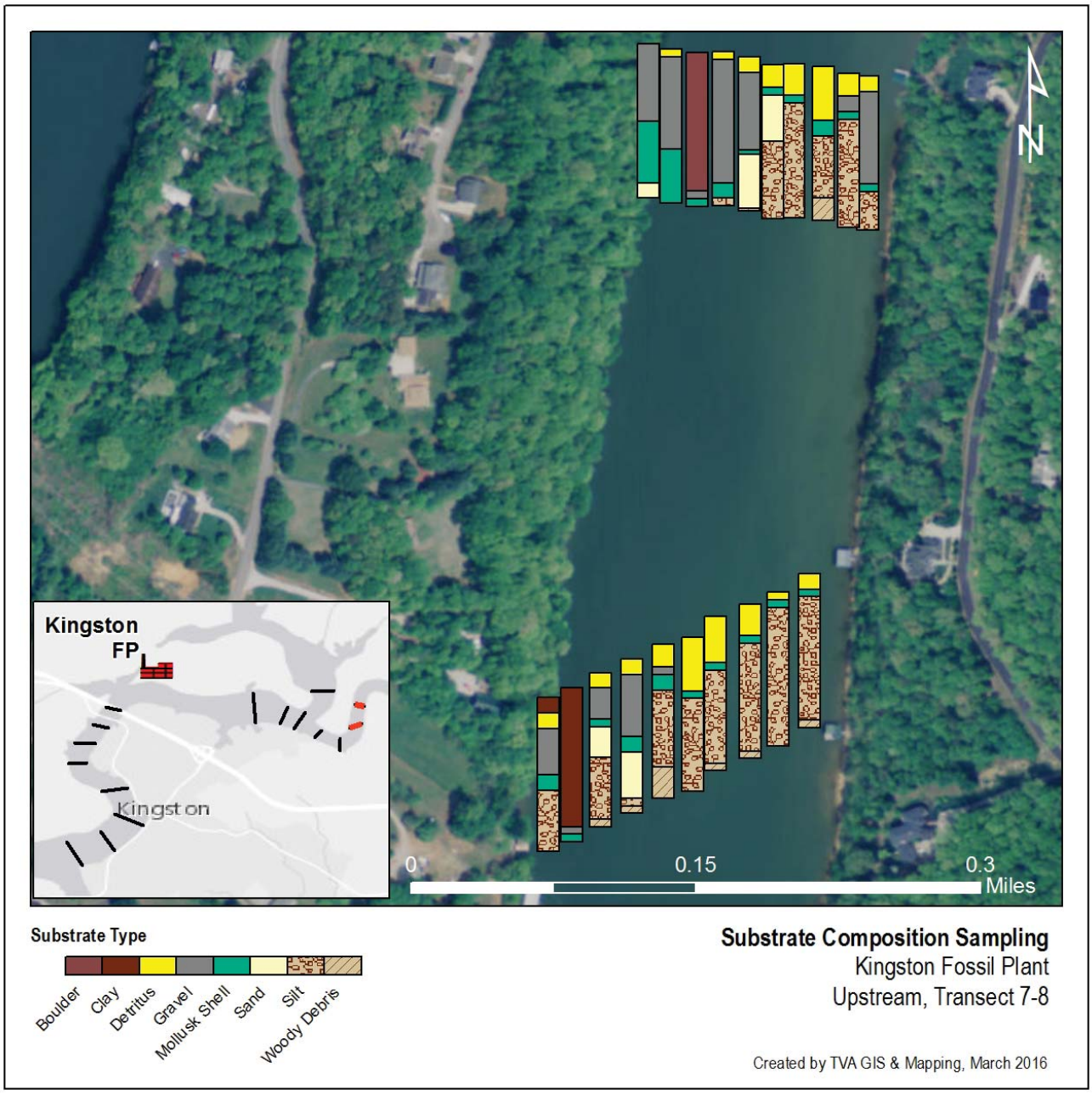

Figure 11. Composition of substrate samples collected at ten points equally spaced along each of transects 7 and 8 upstream of Kingston Fossil Plant

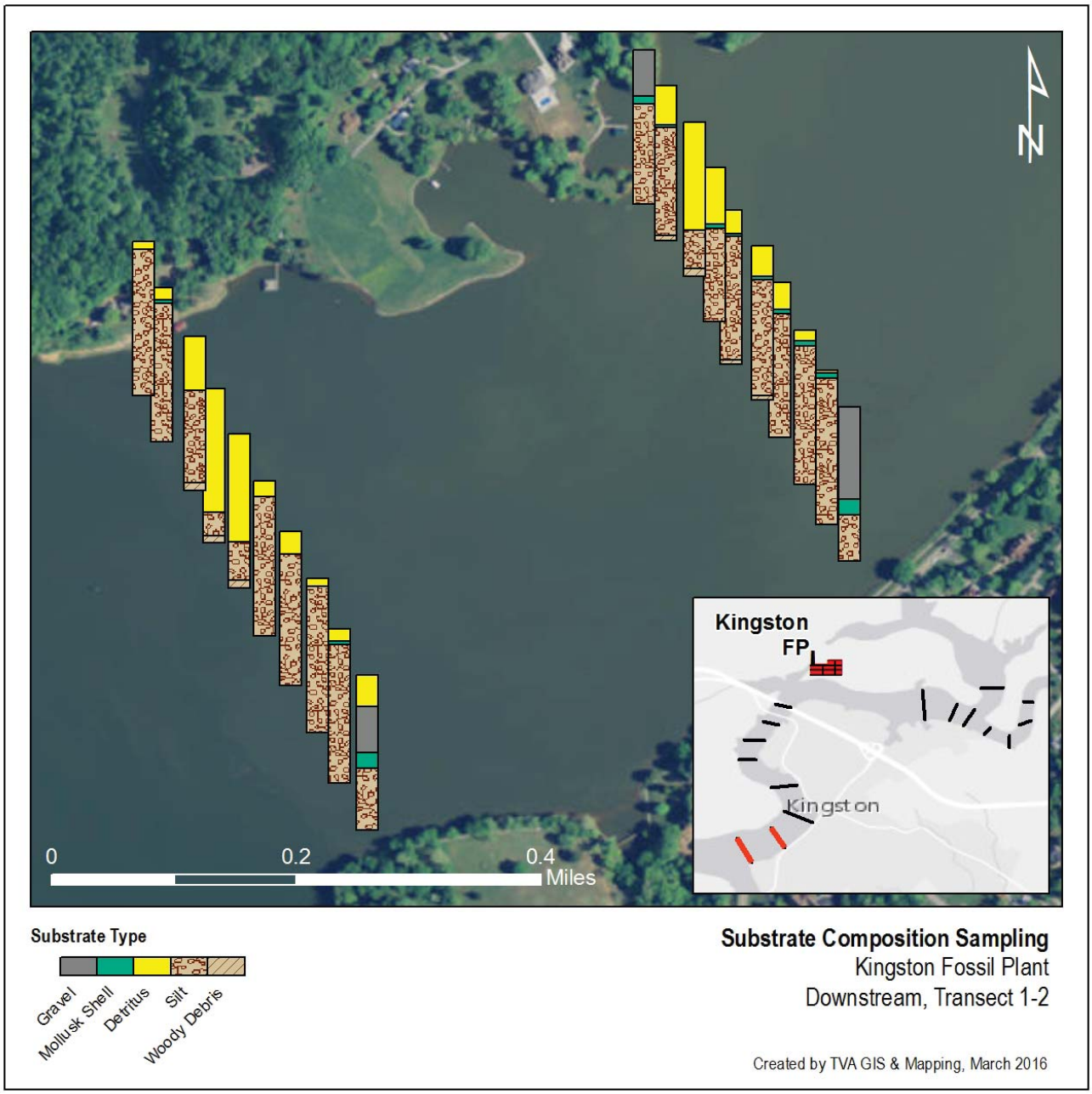

Figure 12. Composition of substrate samples collected at ten points equally spaced along each of transects 1 and 2 downstream of Kingston Fossil Plant

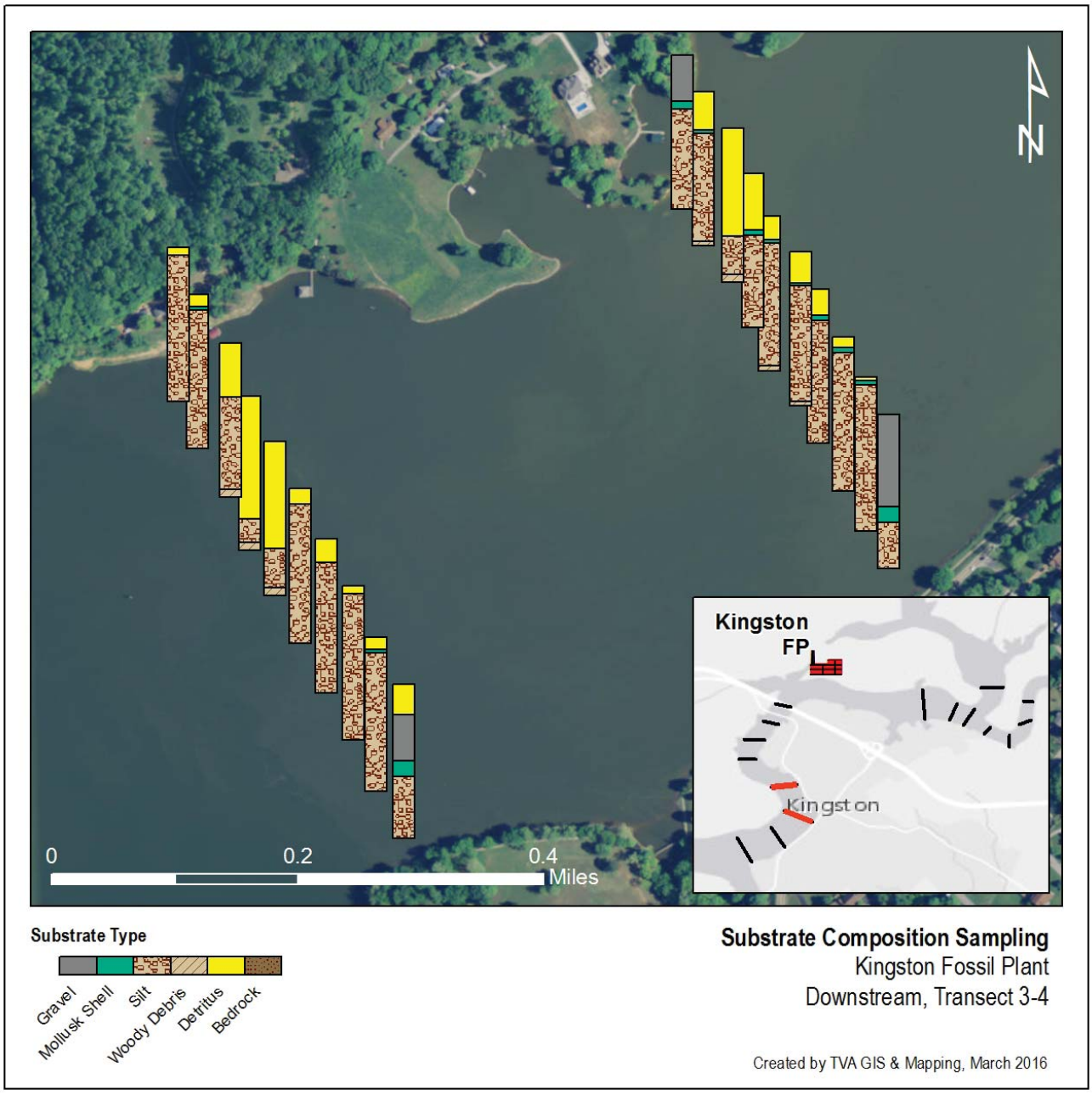

Figure 13. Composition of substrate samples collected at ten points equally spaced along each of transects 3 and 4 downstream of Kingston Fossil Plant

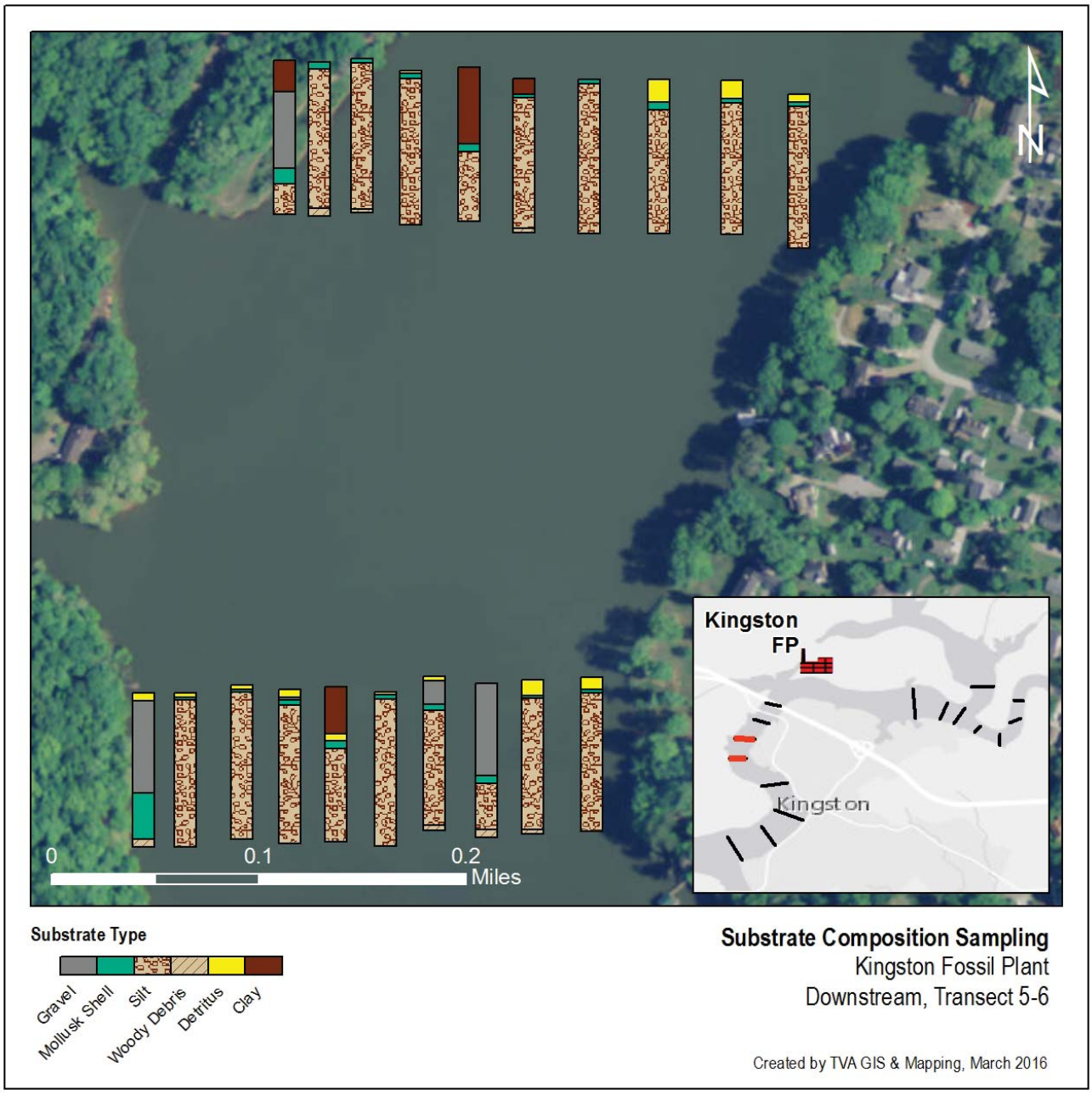

Figure 14. Composition of substrate samples collected at ten points equally spaced along each of transects 5 and 6 downstream of Kingston Fossil Plant

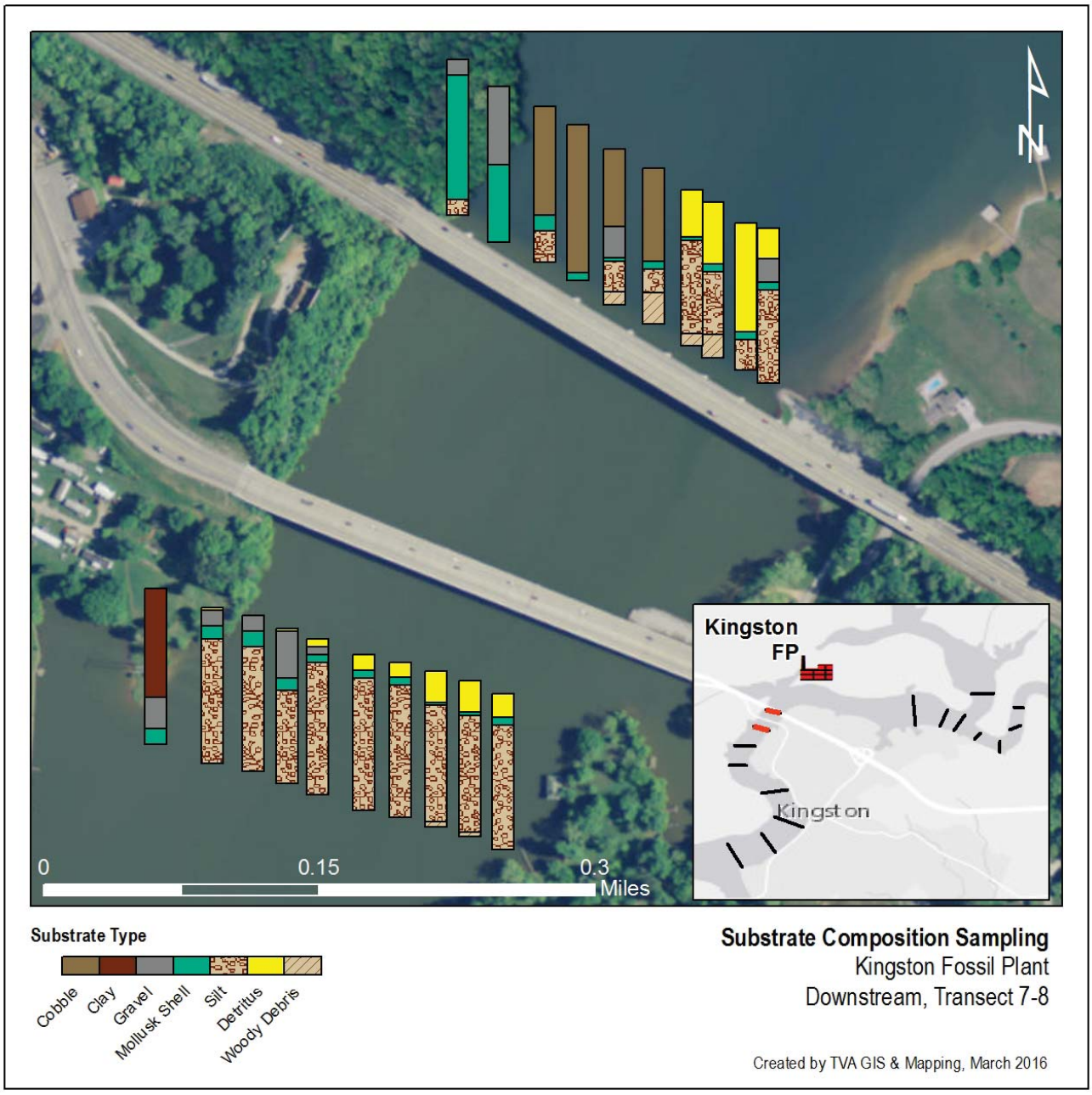

Figure 15. Composition of substrate samples collected at ten points equally spaced along each of transects 7 and 8 downstream of Kingston Fossil Plant

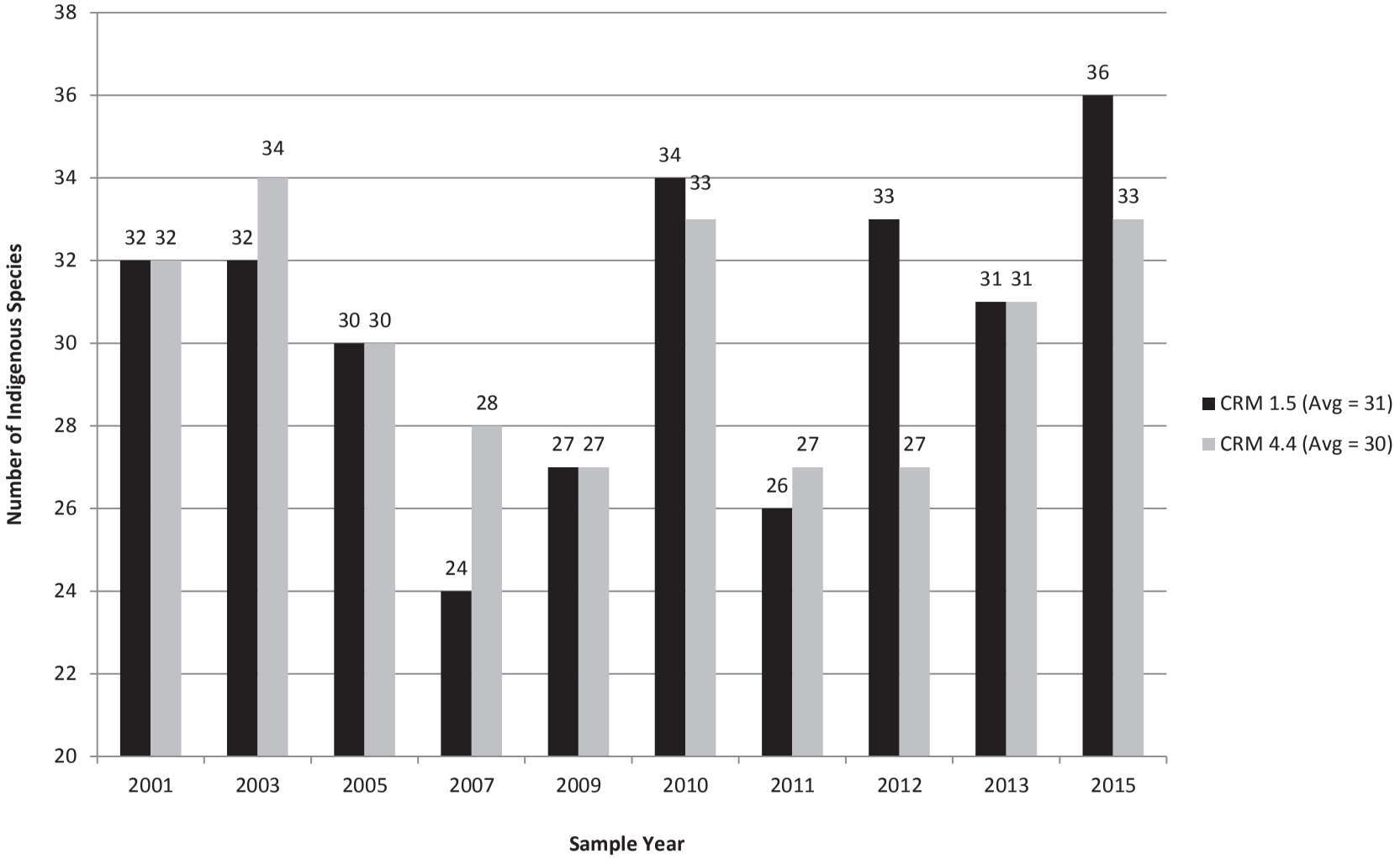

Figure 16. Numbers of indigenous fish species collected during autumn RFAI samples upstream and downstream of KIF from 2001 through 2015

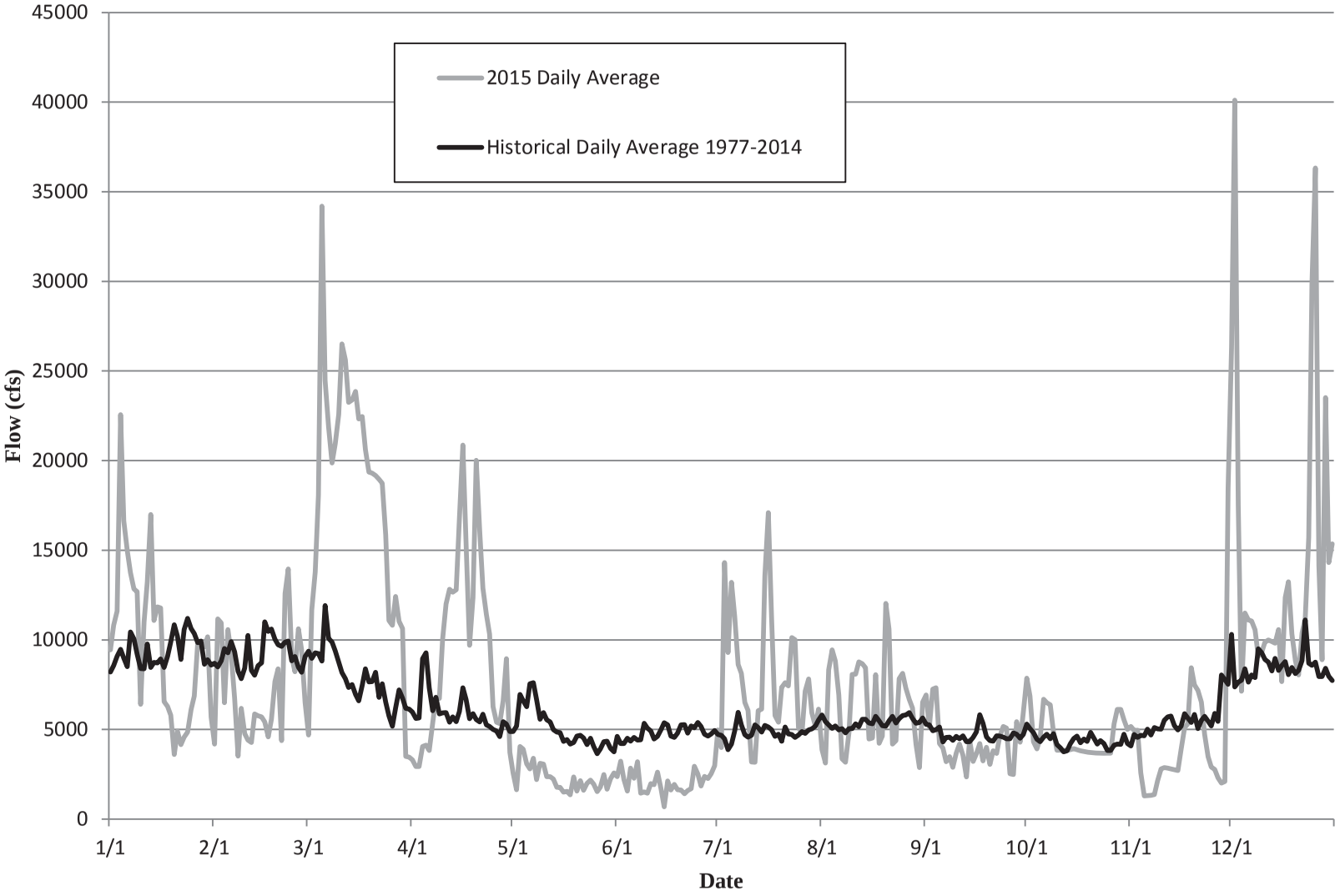

Figure 17. Daily mean flows past Kingston Fossil Plant during 2015, and historic total daily mean flows averaged from 1977-2014

Table 1. Shoreline Aquatic Habitat Index (SAHI) metrics and scoring criteria

Metric	Scoring Criteria	Score
Cover	Stable cover (boulders, rootwads, brush, logs, aquatic vegetation, artificial structures) in 25 to 75 % of the drawdown zone	5
	Stable cover in 10 to 25 % or > 75 % of the drawdown zone	3
	Stable Cover in < 10 % of the drawdown zone	1
Substrate	Percent of drawdown zone with gravel substrate > 40	5
	Percent of drawdown zone with gravel substrate between 10 and 40	3
	Percent substrate gravel < 10	1
Erosion	Little or no evidence of erosion or bank failure. Most bank surfaces stabilized by woody vegetation.	5
	Areas of erosion small and infrequent. Potential for increased erosion due to less desirable vegetation cover (grasses) on > 25 % of bank surfaces.	3
	Areas of erosion extensive, exposed or collapsing banks occur along > 30% of shoreline.	1
Canopy Cover	Tree or shrub canopy > 60 % along adjacent bank	5
	Tree or shrub canopy 30 to 60 % along adjacent bank	3
	Tree or shrub canopy < 30 % along adjacent bank	1
Riparian Zone	Width buffered > 18 meters	5
	Width buffered between 6 and 18 meters	3
	Width buffered < 6 meters	1
Habitat	Habitat diversity optimum. All major habitats (logs, brush, native vegetation, boulders, gravel) present in proportions characteristic of high quality, sufficient to support all life history aspects of target species. Ready access to deeper sanctuary areas present.	5
	Habitat diversity less than optimum. Most major habitats present, but proportion of one is less than desirable, reducing species diversity. No ready access to deeper sanctuary areas.	3
	Habitat diversity is nearly lacking. One habitat dominates, leading to lower species diversity. No ready access to deeper sanctuary areas.	1
Gradient	Drawdown zone gradient abrupt (> 1 meter per 10 meters). Less than 10 percent of shoreline with abrupt gradient due to dredging.	5
	Drawdown zone gradient abrupt. (> 1 meter per 10 meters) in 10 to 40 % of the shoreline resulting from dredging. Rip-rap used to stabilize bank along > 10 % of the shoreline.	3
	Drawdown zone gradient abrupt in > 40 % of the shoreline resulting from dredging. Seawalls used to stabilize bank along > 10 % of the shoreline.	1

Table 2. Expected trophic guild proportions* and expected numbers of fish species* in upper mainstem Tennessee River reservoir transition zones, compared to values observed during Autumn 2015 monitoring at Kingston Fossil Plant

	Transition Zones in Upper Mainstem Tennessee River								Observed Upstream of KIF (CRM 4.4) – Autumn 2015		Observed Downstream of KIF (CRM 1.5) – Autumn 2015	
	Proportion (%)				Number of species							
	Trisected range [a]			Average [b]	Trisected range [a]			Average [b]				
Trophic Guild	-	Expected	+		-	Expected	+		Proportion (%)	Number of Species	Proportion (%)	Number of Species
Benthic Invertivore	< 2.6	2.6 to 5.3	> 5.3	3.2 ± 0.2	< 2	2 to 4	> 4	3.9 ± 0.2	10.8	6	3.2	5
Insectivore	< 25.3	25.3 to 50.7	> 50.7	46.6 ± 2.3	< 4	4 to 9	> 9	9.8 ± 0.5	67.8	11	30.5	12
Top Carnivore	< 18.8	18.8 to 37.6	> 37.6	17.1 ± 0.9	< 5	5 to 9	> 9	10.9 ± 0.5	13.5	12	9.8	13
Omnivore	> 40.3	20.2 to 40.3	< 20.2	28.5 ± 1.4	> 6	3 to 6	< 3	6.8 ± 0.3	7.3	6	10.3	8
Planktivore	> 21.0	10.5 to 21.0	< 10.5	3.1 ± 0.2	0	1	> 1	1.1 ± 0.1	0.6	1	46.1	1
Herbivore	< 0.2	0.2 to 0.4	> 0.4	0.2 ± 0.0	0	1	> 1	1.1 ± 0.1	--	--	--	--
Specialized Insectivore	--	--	--	--	--	--	--	--	0.1	1	0.1	2
Parasitic	--	--	--	--	--	--	--	--	0.1	1	--	--

**Expected values were calculated from data collected over 750 electrofishing runs and 500 overnight experimental gill net sets in transition areas of upper mainstem Tennessee River Reservoirs.*

[a] Trisected ranges are intended to show below expected (-), expected, and above expected (+) values for trophic level proportions and species occurring within the transition zones in upper mainstem Tennessee River reservoirs.

[b] Average expected values are bound by 95% confidence intervals.

Table 3. RFAI scoring criteria (2002) for forebay, transition, and inflow sections of upper mainstem reservoirs in the Tennessee River system

		Scoring Criteria								
		Forebay			Transition			Inflow		
Metric	Gear	1	3	5	1	3	5	1	3	5
1. Total number of indigenous species	Combined	<14	14-27	>27	<15	15-29	>29	<14	14-27	>27
2. Number of centrarchid species	Combined	<2	2-4	>4	<2	2-4	>4	<3	3-4	>4
3. Number of benthic invertivores	Combined	<4	4-7	>7	<4	4-7	>7	<3	3-6	>6
4. Number of intolerant species	Combined	<2	2-4	>4	<2	2-4	>4	<2	2-4	>4
5. Percent of tolerant individuals	Electrofishing	>62%	31-62%	<31%	>62%	31-62%	<31%	>58%	29-58%	<29%
	Gill netting	>28%	14-28%	<14%	>32%	16-32%	<16%			
6. Percent dominance by one species	Electrofishing	>50%	25-50%	<25%	>40%	20-40%	<20%	>46%	23-46%	<23%
	Gill netting	>29%	15-29%	<15%	>28%	14-28%	<14%			
7. Percent of non-indigenous species	Electrofishing	>4%	2-4%	<2%	>6%	3-6%	<3%	>17%	8-17%	<8%
	Gill netting	>16%	8-16%	<8%	>9%	5-9%	<5%			
8. Number of top carnivore species	Combined	<4	4-7	>7	<4	4-7	>7	<3	3-6	>6
9. Percent of individuals as top carnivores	Electrofishing	<5%	5-10%	>10%	<6%	6-11%	>11%	<11%	11-22%	>22%
	Gill netting	<25%	25-50%	>50%	<26%	26-52%	>52%			
10. Percent of individuals as omnivores	Electrofishing	>49%	24-49%	<24%	>44%	22-44%	<22%	>55%	27-55%	<27%
	Gill netting	>34%	17-34%	<17%	>46%	23-46%	<23%			
11. Average number per run	Electrofishing	<121	121-241	>241	<105	105-210	>210	<51	51-102	>102
	Gill netting	<12	12-24	>24	<12	12-24	>24			
12. Percent of individuals with anomalies	Electrofishing	>5%	2-5%	<2%	>5%	2-5%	<2%	>5%	2-5%	<2%
	Gill netting	>5%	2-5%	<2%	>5%	2-5%	<2%			

**Upper mainstem reservoirs include Chickamauga, Fort Loudon, Melton Hill, Nickajack, Tellico, and Watts Bar. Transition scoring criteria were used for sites upstream and downstream of Kingston Fossil Plant.*

Table 4. Scoring criteria for laboratory-processed benthic macroinvertebrate community samples from inflow, transition, and forebay sections of mainstem Tennessee River reservoirs

Benthic Community Metrics	Scoring Criteria								
	Inflow			Transition Zone			Forebay		
	1	3	5	1	3	5	1	3	5
1. Average number of taxa	<4.2	4.2-8.3	>8.3	<3.3	3.3-6.6	>6.6	<2.8	2.8-5.5	>5.5
2. Proportion of samples with long-lived organisms	<0.6	0.6-0.8	>0.8	<0.6	0.6-0.9	>0.9	<0.6	0.6-0.8	>0.8
3. Average number of EPT taxa	<0.9	0.9-1.9	>1.9	<0.6	0.6-1.4	>1.4	<0.6	0.6-0.9	>0.9
4. Average proportion of oligochaete individuals	>23.9	23.9-12.0	<12.0	>21.9	21.9-11.0	<11.0	>41.9	41.9-21.0	<21.0
5. Average proportion of total abundance comprised by the two most abundant taxa	>86.2	86.2-73.1	<73.1	>87.9	87.9-77.8	<77.8	>90.3	90.3-81.7	<81.7
6. Average density excluding chironomids and oligochaetes	<400.0	400.0-799.9	>799.9	<305.0	305.0-609.9	>609.9	<125.0	125.0-249.9	>249.9
7. Zero Samples: proportion of samples containing no organisms	>0	-	0	>0	-	0	>0	-	0

Transition scoring criteria were used to score sites upstream and downstream of KIF.

Table 5. Daily average intake and discharge temperatures (°F) and flow rates (mgd) of the condenser circulating water (CCW) system, and the daily average generation (MW) at Kingston Fossil Plant during 2015

Date	Intake Temp	Discharge Temp	Flow	MW	Date	Intake Temp	Discharge Temp	Flow	MW	Date	Intake Temp	Discharge Temp	Flow	MW
1/1/2015	44.20	42.37	679	0.5	2/26/2015	37.04	48.23	1279	953.0	4/23/2015	59.56	56.94	372	0.4
1/2/2015	43.17	41.35	679	0.5	2/27/2015	37.10	47.24	1279	940.9	4/24/2015	58.41	55.72	372	0.4
1/3/2015	42.62	40.70	679	0.5	2/28/2015	37.72	46.63	1279	841.9	4/25/2015	58.08	54.83	372	0.4
1/4/2015	43.81	42.21	1158	29.9	3/1/2015	38.59	44.63	1279	584.8	4/26/2015	58.10	54.93	372	0.4
1/5/2015	47.94	51.70	1158	418.1	3/2/2015	39.41	49.08	1279	935.4	4/27/2015	58.40	55.34	372	0.4
1/6/2015	46.36	49.40	1357	506.0	3/3/2015	40.63	49.03	1202	809.7	4/28/2015	58.20	55.10	372	0.4
1/7/2015	43.79	50.20	1357	657.6	3/4/2015	42.54	51.00	1202	822.9	4/29/2015	57.99	54.83	299	0.4
1/8/2015	40.77	50.24	1357	942.8	3/5/2015	43.80	53.84	1202	996.0	4/30/2015	57.95	54.76	299	0.4
1/9/2015	40.02	48.42	1357	871.9	3/6/2015	41.32	50.31	1202	878.9	5/1/2015	58.16	55.01	299	0.3
1/10/2015	38.92	49.28	1357	1039.3	3/7/2015	40.39	47.31	1202	643.7	5/2/2015	58.27	55.14	372	0.7
1/11/2015	38.69	47.28	1357	881.3	3/8/2015	41.40	48.10	1202	586.2	5/3/2015	58.64	55.49	372	0.7
1/12/2015	39.11	47.85	1357	888.2	3/9/2015	43.76	49.11	1202	542.1	5/4/2015	59.15	60.13	665	225.8
1/13/2015	36.26	45.89	1357	954.3	3/10/2015	46.46	51.67	1202	575.7	5/5/2015	60.51	64.93	831	424.2
1/14/2015	38.75	45.73	1357	705.7	3/11/2015	46.83	51.20	1202	353.5	5/6/2015	62.73	66.88	980	550.5
1/15/2015	40.48	51.18	1357	1099.8	3/12/2015	48.96	51.09	1202	172.1	5/7/2015	63.77	69.38	892	706.3
1/16/2015	40.59	49.20	1357	909.9	3/13/2015	50.24	51.70	754	140.2	5/8/2015	64.86	71.63	1142	825.5
1/17/2015	40.39	49.02	1357	854.9	3/14/2015	50.86	52.98	754	178.5	5/9/2015	66.85	73.51	1142	820.8
1/18/2015	40.64	46.34	1357	566.8	3/15/2015	51.32	52.67	754	141.1	5/10/2015	67.87	76.43	1060	950.0
1/19/2015	40.93	48.59	1357	804.8	3/16/2015	51.87	54.52	754	207.1	5/11/2015	67.65	75.36	1060	866.9
1/20/2015	41.78	49.11	1357	766.5	3/17/2015	53.20	55.45	754	193.3	5/12/2015	67.89	75.53	1060	859.0
1/21/2015	43.35	51.52	1357	875.3	3/18/2015	52.60	54.90	754	203.8	5/13/2015	68.64	75.60	1060	793.6
1/22/2015	43.78	53.52	1357	1047.8	3/19/2015	51.70	54.14	754	226.4	5/14/2015	67.61	75.47	1060	810.3
1/23/2015	43.72	52.52	1357	954.0	3/20/2015	51.20	48.08	754	17.4	5/15/2015	67.97	76.04	1060	832.8
1/24/2015	42.77	50.66	1357	833.4	3/21/2015	51.04	47.91	601	0.4	5/16/2015	68.47	75.92	1060	650.7
1/25/2015	41.92	48.21	1357	686.7	3/22/2015	50.59	47.47	601	0.4	5/17/2015	68.78	75.94	1060	761.8
1/26/2015	41.73	50.46	1357	928.1	3/23/2015	50.46	47.85	601	0.4	5/18/2015	69.76	77.00	1060	759.8
1/27/2015	41.36	48.33	1226	751.9	3/24/2015	50.92	48.36	601	0.7	5/19/2015	70.48	77.75	1060	756.1
1/28/2015	40.95	46.75	1226	627.1	3/25/2015	51.39	48.84	601	0.6	5/20/2015	70.36	77.26	1060	719.9
1/29/2015	41.45	46.73	1226	577.0	3/26/2015	52.46	49.88	601	0.5	5/21/2015	70.12	76.94	1060	721.9
1/30/2015	41.82	46.62	1226	535.4	3/27/2015	51.98	49.54	601	0.5	5/22/2015	71.12	77.45	1060	683.5
1/31/2015	41.88	44.44	1226	318.7	3/28/2015	51.60	49.49	520	0.4	5/23/2015	70.75	77.33	1060	698.7
2/1/2015	41.84	43.96	1226	275.5	3/29/2015	51.38	49.14	520	0.4	5/24/2015	70.42	77.69	1060	751.5
2/2/2015	40.99	44.56	1226	376.8	3/30/2015	52.86	50.18	520	0.5	5/25/2015	70.68	77.08	1060	665.1
2/3/2015	39.98	42.88	919	360.5	3/31/2015	53.52	50.90	520	0.4	5/26/2015	71.29	79.10	1060	765.1
2/4/2015	40.59	43.35	919	351.4	4/1/2015	54.81	52.31	520	0.5	5/27/2015	71.50	77.27	1060	612.5
2/5/2015	40.68	42.74	919	262.2	4/2/2015	54.91	52.40	520	0.4	5/28/2015	71.99	78.31	1122	670.2
2/6/2015	39.85	42.35	919	337.7	4/3/2015	55.50	52.58	520	0.4	5/29/2015	72.99	79.93	1122	720.2
2/7/2015	39.83	37.88	919	70.8	4/4/2015	55.33	52.97	520	0.4	5/30/2015	72.56	79.31	1122	708.2
2/8/2015	40.51	37.90	919	0.5	4/5/2015	55.00	53.06	520	0.4	5/31/2015	72.84	79.56	1122	707.4
2/9/2015	41.21	38.58	679	0.7	4/6/2015	55.96	53.49	520	0.4	6/1/2015	73.45	77.59	1122	483.5
2/10/2015	41.93	40.32	1357	109.8	4/7/2015	56.83	54.13	520	0.4	6/2/2015	73.73	73.09	909	250.3
2/11/2015	42.05	42.91	1357	346.7	4/8/2015	57.49	54.56	520	0.4	6/3/2015	73.56	72.92	909	250.8
2/12/2015	42.78	49.41	1357	694.3	4/9/2015	57.59	54.48	520	0.3	6/4/2015	72.70	72.27	909	283.9
2/13/2015	42.30	51.41	1357	864.2	4/10/2015	58.82	55.92	520	0.3	6/5/2015	72.27	71.34	909	223.7
2/14/2015	43.30	52.35	1357	892.7	4/11/2015	59.37	57.19	520	0.4	6/6/2015	72.23	71.18	1274	210.1
2/15/2015	41.71	50.97	1357	906.5	4/12/2015	59.67	57.51	520	0.4	6/7/2015	72.34	72.70	1274	361.7
2/16/2015	42.06	51.85	1357	945.6	4/13/2015	60.23	57.68	520	0.4	6/8/2015	72.48	78.34	1122	634.1
2/17/2015	40.52	50.99	1357	1007.9	4/14/2015	60.75	57.78	520	0.4	6/9/2015	74.42	82.00	1122	759.3
2/18/2015	40.25	50.00	1357	929.6	4/15/2015	61.08	57.91	507	0.4	6/10/2015	76.21	84.82	1184	842.7
2/19/2015	39.02	50.11	1357	1002.1	4/16/2015	60.68	58.15	507	0.4	6/11/2015	76.30	84.78	1184	831.3
2/20/2015	38.80	53.93	1357	1379.9	4/17/2015	59.97	57.39	424	0.4	6/12/2015	76.82	85.72	1184	869.4
2/21/2015	39.22	52.72	1357	1197.3	4/18/2015	60.18	57.55	585	0.4	6/13/2015	78.28	87.59	1274	935.8
2/22/2015	35.33	47.17	1357	1011.0	4/19/2015	60.27	57.67	666	0.4	6/14/2015	78.37	87.64	1274	924.4
2/23/2015	33.34	45.91	1357	1070.7	4/20/2015	61.14	58.59	588	0.4	6/15/2015	77.50	87.47	1274	993.3
2/24/2015	36.13	47.62	1279	1036.6	4/21/2015	60.46	57.88	588	0.4	6/16/2015	77.93	89.24	1274	1080.6
2/25/2015	36.89	49.55	1279	1093.5	4/22/2015	60.21	57.53	588	0.4	6/17/2015	78.11	88.85	1274	1038.4

Table 5. (Continued).

Date	Intake Temp	Discharge Temp	Flow	MW	Date	Intake Temp	Discharge Temp	Flow	MW	Date	Intake Temp	Discharge Temp	Flow	MW
6/18/2015	78.99	89.44	1274	1030.9	8/23/2015	69.64	78.33	1357	905.0	10/28/2015	63.80	60.88	311	0.9
6/19/2015	78.98	90.44	1274	1040.2	8/24/2015	70.89	80.01	1357	942.9	10/29/2015	63.58	60.75	311	0.4
6/20/2015	79.17	89.87	1274	975.1	8/25/2015	69.82	77.69	1357	842.7	10/30/2015	62.85	59.98	311	0.3
6/21/2015	80.42	91.16	1274	978.0	8/26/2015	68.29	77.69	1357	969.0	10/31/2015	62.49	59.58	249	0.3
6/22/2015	80.43	90.12	1274	930.4	8/27/2015	68.18	76.29	1357	857.8	11/1/2015	62.52	59.75	311	0.5
6/23/2015	80.40	90.99	1274	1046.3	8/28/2015	69.05	77.39	1357	879.9	11/2/2015	62.41	59.67	311	0.3
6/24/2015	80.25	90.02	1274	977.8	8/29/2015	69.85	78.05	1357	851.8	11/3/2015	62.61	59.73	311	0.3
6/25/2015	80.49	90.38	1274	982.4	8/30/2015	70.08	76.89	1357	720.5	11/4/2015	62.88	60.00	311	0.4
6/26/2015	80.51	89.78	1274	924.5	8/31/2015	71.11	81.30	1357	1021.9	11/5/2015	62.95	60.10	311	0.3
6/27/2015	80.06	84.09	1274	655.6	9/1/2015	69.96	78.90	1357	907.3	11/6/2015	62.81	60.03	311	0.3
6/28/2015	79.47	84.07	1274	681.5	9/2/2015	68.81	77.85	1357	911.5	11/7/2015	62.48	59.71	393	0.4
6/29/2015	78.93	84.23	1274	706.3	9/3/2015	69.44	79.14	1357	964.2	11/8/2015	62.37	59.93	547	24.8
6/30/2015	78.37	83.27	1193	685.5	9/4/2015	69.04	79.63	1357	1046.7	11/9/2015	61.95	61.72	800	257.3
7/1/2015	79.00	82.96	1112	555.7	9/5/2015	68.78	77.57	1357	941.9	11/10/2015	61.67	64.33	878	304.9
7/2/2015	76.63	81.45	1112	614.7	9/6/2015	70.16	78.58	1357	942.2	11/11/2015	61.09	64.77	800	352.5
7/3/2015	72.46	76.70	1193	476.3	9/7/2015	72.04	80.95	1357	940.1	11/12/2015	61.17	63.89	800	291.4
7/4/2015	69.35	72.85	1193	476.8	9/8/2015	72.59	82.57	1357	1040.6	11/13/2015	60.70	64.13	800	328.0
7/5/2015	69.55	73.84	1193	580.9	9/9/2015	73.16	84.09	1357	1143.0	11/14/2015	59.43	63.42	728	356.0
7/6/2015	68.17	72.54	1193	622.5	9/10/2015	73.59	80.05	1357	714.4	11/15/2015	58.48	62.36	800	345.0
7/7/2015	68.52	74.10	1276	807.6	9/11/2015	72.82	81.62	1357	928.7	11/16/2015	57.49	62.31	800	386.6
7/8/2015	69.07	73.59	1276	685.1	9/12/2015	72.58	77.32	1357	508.5	11/17/2015	57.44	61.41	800	337.6
7/9/2015	70.30	75.10	1276	732.4	9/13/2015	72.37	76.24	1357	432.0	11/18/2015	57.82	63.15	854	400.8
7/10/2015	71.29	75.81	1276	693.7	9/14/2015	72.19	80.18	1357	708.0	11/19/2015	57.70	62.66	931	369.8
7/11/2015	72.48	77.02	1276	697.2	9/15/2015	70.76	77.88	1357	697.3	11/20/2015	55.00	61.11	990	450.6
7/12/2015	73.84	78.00	1276	706.0	9/16/2015	71.25	78.31	1357	706.6	11/21/2015	53.21	59.50	990	502.2
7/13/2015	75.33	81.61	1357	878.7	9/17/2015	71.15	78.69	1357	703.3	11/22/2015	52.79	59.15	990	506.8
7/14/2015	75.47	80.23	1357	826.8	9/18/2015	71.24	75.02	1357	574.3	11/23/2015	52.16	61.18	1202	706.8
7/15/2015	75.60	80.14	1357	791.3	9/19/2015	71.43	74.44	1357	575.4	11/24/2015	52.35	60.99	1202	732.9
7/16/2015	72.11	76.82	1357	812.5	9/20/2015	71.49	73.71	1357	504.5	11/25/2015	52.48	58.42	1140	554.3
7/17/2015	71.35	76.32	1357	850.6	9/21/2015	72.00	74.62	1357	547.4	11/26/2015	52.50	55.23	919	251.9
7/18/2015	71.74	77.97	1357	926.8	9/22/2015	71.60	74.42	1357	568.1	11/27/2015	52.08	54.80	919	250.0
7/19/2015	72.47	81.75	1357	1020.0	9/23/2015	71.33	74.23	1357	574.6	11/28/2015	52.12	56.15	919	313.6
7/20/2015	72.96	82.88	1357	1076.7	9/24/2015	71.00	73.39	1357	524.0	11/29/2015	52.13	57.19	919	365.2
7/21/2015	71.61	80.91	1357	1019.4	9/25/2015	69.58	71.07	1357	449.8	11/30/2015	51.14	55.65	919	314.6
7/22/2015	69.53	77.71	1357	912.7	9/26/2015	68.91	70.01	992	409.4	12/1/2015	55.55	60.40	910	256.9
7/23/2015	69.63	75.90	1357	729.5	9/27/2015	69.26	70.44	992	416.6	12/2/2015	56.41	55.40	828	167.5
7/24/2015	69.59	78.35	1357	971.2	9/28/2015	70.14	71.32	992	426.5	12/3/2015	54.70	54.20	828	250.1
7/25/2015	70.61	79.47	1357	974.0	9/29/2015	70.09	72.04	992	454.6	12/4/2015	52.70	52.54	828	302.3
7/26/2015	70.98	80.29	1357	1012.3	9/30/2015	69.71	71.89	992	481.8	12/5/2015	50.78	49.90	828	198.3
7/27/2015	71.45	81.83	1357	1106.6	10/1/2015	68.85	67.73	992	222.4	12/6/2015	49.23	48.19	828	169.7
7/28/2015	70.60	81.48	1357	1160.4	10/2/2015	67.77	64.66	530	84.2	12/7/2015	48.51	47.48	828	167.5
7/29/2015	68.56	78.84	1357	1110.5	10/3/2015	66.96	62.62	613	0.4	12/8/2015	47.71	47.39	828	277.1
7/30/2015	68.91	78.61	1357	1047.8	10/4/2015	67.34	63.06	675	0.3	12/9/2015	47.27	46.97	828	280.1
7/31/2015	69.83	78.08	1357	904.0	10/5/2015	67.72	63.49	613	0.4	12/10/2015	47.44	46.06	828	175.5
8/1/2015	70.08	78.66	1357	934.5	10/6/2015	68.27	65.32	675	82.9	12/11/2015	48.20	46.81	751	175.4
8/2/2015	70.62	79.09	1357	935.6	10/7/2015	68.41	66.85	554	174.3	12/12/2015	49.17	47.75	751	175.2
8/3/2015	71.64	79.25	1357	854.4	10/8/2015	67.96	67.22	554	173.0	12/13/2015	49.95	48.53	751	176.1
8/4/2015	69.18	73.66	1267	775.7	10/9/2015	67.61	66.74	554	172.6	12/14/2015	51.13	49.69	751	176.1
8/5/2015	68.12	71.85	1267	683.5	10/10/2015	66.96	66.00	458	173.5	12/15/2015	51.33	49.87	751	166.6
8/6/2015	68.58	71.30	1267	552.1	10/11/2015	66.61	65.65	458	173.2	12/16/2015	50.99	48.50	756	19.1
8/7/2015	69.09	72.32	1185	612.2	10/12/2015	66.63	65.65	458	172.2	12/17/2015	51.48	48.88	756	0.4
8/8/2015	69.93	73.05	1267	599.8	10/13/2015	66.70	65.71	458	163.0	12/18/2015	50.92	48.41	516	0.4
8/9/2015	71.57	75.78	1357	706.4	10/14/2015	66.17	65.49	458	168.4	12/19/2015	49.50	47.05	679	0.4
8/10/2015	71.51	78.49	1357	715.4	10/15/2015	65.98	65.38	410	168.0	12/20/2015	47.79	45.35	679	0.4
8/11/2015	68.29	77.68	1357	973.2	10/16/2015	66.09	65.33	410	166.1	12/21/2015	46.35	43.93	679	0.4
8/12/2015	67.19	74.79	1357	878.4	10/17/2015	65.45	64.85	410	169.2	12/22/2015	45.45	43.03	679	0.4
8/13/2015	67.00	76.73	1357	927.9	10/18/2015	64.50	63.90	482	166.4	12/23/2015	45.10	42.67	679	0.4
8/14/2015	67.25	75.53	1357	871.4	10/19/2015	63.68	63.01	482	158.2	12/24/2015	50.55	48.06	679	0.5
8/15/2015	67.00	74.03	1357	773.0	10/20/2015	63.65	62.70	399	155.1	12/25/2015	55.17	52.64	679	0.5
8/16/2015	67.71	73.79	1357	702.8	10/21/2015	63.41	62.45	399	163.4	12/26/2015	56.79	54.23	679	0.5
8/17/2015	68.47	75.99	1357	832.8	10/22/2015	63.48	62.51	327	158.7	12/27/2015	57.44	54.86	679	0.5
8/18/2015	67.04	76.69	1357	1024.6	10/23/2015	63.31	62.42	327	162.0	12/28/2015	58.15	55.56	679	0.5
8/19/2015	67.54	76.28	1357	930.1	10/24/2015	63.97	62.78	327	155.8	12/29/2015	58.94	56.36	751	0.5
8/20/2015	69.48	78.79	1357	970.8	10/25/2015	64.73	63.51	327	153.1	12/30/2015	58.39	56.73	751	137.4
8/21/2015	70.90	79.59	1357	914.5	10/26/2015	64.93	63.74	327	162.3	12/31/2015	56.70	55.11	751	150.3
8/22/2015	68.85	76.97	1357	878.6	10/27/2015	64.18	62.58	327	125.6					

Table 6. Shoreline aquatic habitat index (SAHI) scores for shoreline sections assessed within the RFAI sample reach upstream of Kingston Fossil Plant, autumn 2015

Left Descending Bank	Transects 1	2	3	4	5	6	7	8	Avg.
Aquatic Macrophytes	0%	0%	0%	0%	0%	0%	0%	0%	0%
SAHI Variables									
Cover	5	3	3	5	5	1	3	1	3.3
Substrate	5	1	1	1	3	5	5	5	3.3
Erosion	1	5	5	1	3	5	5	5	3.8
Canopy Cover	5	5	1	5	5	5	5	5	4.5
Riparian Zone	1	1	1	1	3	5	5	5	2.8
Habitat	5	3	1	5	3	1	3	1	2.8
Slope	3	1	5	3	3	1	5	5	3.3
Total	**25**	**19**	**17**	**21**	**25**	**23**	**31**	**27**	**23.5**
Rating	**Fair**	**Fair**	**Fair**	**Fair**	**Fair**	**Fair**	**Good**	**Good**	**Fair**

Right Descending Bank	Transects 1	2	3	4	5	6	7	8	Avg.
Aquatic Macrophytes	0%	0%	0%	0%	0%	0%	0%	0%	0%
SAHI Variables									
Cover	3	3	1	5	5	3	5	5	3.8
Substrate	1	1	1	1	1	3	3	3	1.8
Erosion	3	3	5	1	5	5	3	3	3.5
Canopy Cover	5	5	5	5	5	3	3	5	4.5
Riparian Zone	5	5	5	5	5	1	1	5	4.0
Habitat	3	3	1	3	3	3	3	3	2.8
Slope	3	5	5	5	3	5	1	1	3.5
Total	**23**	**25**	**23**	**25**	**27**	**23**	**19**	**25**	**23.75**
Rating	**Fair**	**Fair**	**Fair**	**Fair**	**Good**	**Fair**	**Fair**	**Fair**	**Fair**

[*] *Scoring criteria: poor (7-16), fair (17-26), good (27-35)*

Table 7. Shoreline aquatic habitat index (SAHI) scores for shoreline sections assessed within the RFAI sample reach downstream of Kingston Fossil Plant, autumn 2015

Left Descending Bank	Transects 1	2	3	4	5	6	7	8	Avg.
Aquatic Macrophytes	0%	40%	60%	0%	0%	0%	0%	0%	13%
SAHI Variables									
Cover	3	5	1	5	5	5	5	1	3.8
Substrate	5	5	5	1	3	1	5	1	3.3
Erosion	5	5	5	5	3	5	3	5	4.5
Canopy Cover	5	1	1	1	5	3	1	1	2.3
Riparian Zone	5	1	1	1	3	1	1	1	1.8
Habitat	1	3	3	3	3	5	3	1	2.8
Slope	3	3	3	3	1	1	5	5	3.0
Total	**27**	**23**	**19**	**19**	**23**	**21**	**23**	**15**	**21.3**
Rating	**Good**	**Fair**	**Fair**	**Fair**	**Fair**	**Fair**	**Fair**	**Poor**	**Fair**

Right Descending Bank	Transects 1	2	3	4	5	6	7	8	Avg.
Aquatic Macrophytes	0%	0%	0%	0%	0%	0%	0%	0%	0%
SAHI Variables									
Cover	1	3	5	5	3	1	1	3	2.8
Substrate	5	5	3	3	5	5	3	1	3.8
Erosion	5	1	5	5	5	5	3	5	4.3
Canopy Cover	1	3	1	5	5	3	1	5	3.0
Riparian Zone	1	1	1	5	5	3	1	5	2.8
Habitat	1	1	3	3	3	1	1	3	2.0
Slope	1	1	1	1	1	5	5	1	2.0
Total	**15**	**15**	**19**	**27**	**27**	**23**	**15**	**23**	**20.5**
Rating	**Poor**	**Poor**	**Fair**	**Good**	**Good**	**Fair**	**Poor**	**Fair**	**Fair**

[*] *Scoring criteria: poor (7-16), fair (17-26), good (27-35)*

Table 8. Substrate composition and average water depth (ft) per transect upstream and downstream of Kingston Fossil Plant, Autumn 2015

	% Substrate per transect upstream of KIF								
Substrate Type	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Avg.**
Silt	26.5	49.5	46.5	27.0	42.5	36.4	53.5	61.5	**42.9**
Detritus	11.5	14.5	19.0	30.5	26.8	41.1	24..0	15.0	**22.6**
Mollusk Shell	12.3	6.5	15.0	13.0	5.5	10.0	4.5	4.7	**8.9**
Gravel	31.5	10.0	3.0	6.5	3.2	5.0	3.0	8.0	**8.8**
Wood	1.7	4.5	2.5	6.0	3.0	5.5	7.0	4.3	**4.3**
Sand	7.5	5.0	3.0	0.0	10.5	2.0	0.0	0.0	**3.5**
Clay	0.0	10.0	0.0	2.0	2.0	0.0	8.0	0.0	**2.8**
Cobble	0.0	0.0	0.0	14.0	0.0	0.0	0.0	0.0	**1.8**
Bedrock	0.0	0.0	10.0	0.0	0.0	0.0	0.0	0.0	**1.3**
Boulder	9.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**1.1**
Coal	0.0	0.0	1.0	0.0	0.0	0.0	0.0	6.5	**0.9**
Coal Ash	0.0	0.0	0.0	1.0	6.5	0.0	0.0	0.0	**0.9**
Average depth (ft)	22.7	22.7	20.3	22.2	9.9	17.4	15.4	12.2	**17.9**
Actual depth range: 1.8 to 40.2 ft									

	% Substrate per transect downstream of KIF								
Substrate Type	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Avg.**
Silt	68.5	67.0	77.0	77.0	71.5	78.4	70.5	25.0	**66.9**
Detritus	25.6	19.3	5.4	5.5	4.4	3.4	8.4	16.0	**11.0**
Gravel	3.0	9.0	9.0	0.5	13.7	5.0	7.5	9.5	**7.2**
Mollusk Shell	1.4	3.3	5.6	11.6	5.8	4.2	6.0	16.9	**6.9**
Cobble	0.0	0.0	0.0	4.0	0.0	0.0	0.0	27.5	**3.9**
Clay	0.0	0.0	0.0	0.0	3.0	8.0	7.0	0.0	**2.3**
Wood	1.5	1.4	1.5	1.4	1.6	1.0	0.6	5.1	**1.8**
Submerged Vegetation	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0	**0.2**
Average depth (ft)	16.3	15.8	16.7	21.8	23.9	18.5	23.1	21.0	**19.6**
Actual depth range: 1.6 to 45.0 ft									

Table 9. Individual metric scores and the overall RFAI scores at sites upstream (CRM 4.4) and downstream (CRM 1.5) of Kingston Fossil Plant during Autumn 2015

Autumn 2015 Metric		CRM 4.4 Observations	Score	CRM 1.5 Observations	Score
A. Species richness and composition					
1. Number of indigenous species (Tables 10 and 11)	Combined	**33**	**5**	**36**	**5**
2. Number of centrarchid species (less *Micropterus*)	Combined	**6** Black crappie Bluegill Green sunfish Longear sunfish Redear sunfish Warmouth	**5**	**7** Black crappie Bluegill Green sunfish Longear sunfish Redear sunfish Warmouth White crappie	**5**
3. Number of benthic invertivore species	Combined	**6** Black redhorse Freshwater drum Golden redhorse Logperch Northern hog sucker Spotted sucker	**3**	**5** Freshwater drum Golden redhorse Logperch Northern hog sucker Spotted sucker	**3**
4. Number of intolerant species	Combined	**8** Black redhorse Brook silverside Longear sunfish Northern hog sucker Rock bass Skipjack herring Smallmouth bass Spotted sucker	**5**	**7** Brook silverside Longear sunfish Northern hog sucker Rock bass Skipjack herring Smallmouth bass Spotted sucker	**5**

Table 9. (Continued)

Autumn 2015 Metric		CRM 4.4 Observations		Score	CRM 1.5 Observations		Score
5. Percent tolerant individuals	Electrofishing	**58.9%**			**29.9%**		
		Bluegill	40.9%		Bluegill	12.3%	
		Bluntnose minnow	0.1%		Bluntnose minnow	0.1%	
		Common carp	1.4%		Common carp	0.4%	
		Gizzard shad	2.1%	**1.5**	Gizzard shad	7.4%	**2.5**
		Green sunfish	0.2%		Green sunfish	0.3%	
		Largemouth bass	8.5%		Largemouth bass	5.6%	
		Spotfin shiner	5.8%		Redbreast sunfish	0.1%	
					Spotfin shiner	3.5%	
					White crappie	<0.1%	
	Gill Netting	**17.7%**			**10.6%**		
		Bluegill	0.8%		Bluegill	0.7%	
		Common carp	1.5%	**1.5**	Common carp	2.1%	**2.5**
		Gizzard shad	13.8%		Gizzard shad	6.4%	
		Largemouth bass	1.5%		Largemouth bass	0.7%	
6. Percent dominance by one species	Electrofishing	**40.9%**		**0.5**	**49.1%**		**0.5**
		Bluegill			Threadfin		
	Gill Netting	**16.9%**		**1.5**	**21.3%**		**1.5**
		Walleye			White bass		
7. Percent non-indigenous species	Electrofishing	**23.1%**			**12.7%**		
		Common carp	1.4%		Common carp	0.4%	
		Mississippi silverside	21.6%	**0.5**	Mississippi silverside	12.1%	**0.5**
		Yellow perch	0.2%		Redbreast sunfish	0.1%	
					Striped bass	<0.1%	
					Yellow perch	<0.1%	
	Gill Netting	**13.8%**			**9.2%**		
		Common carp	1.5%	**0.5**	Common carp	2.1%	**0.5**
		Striped bass	12.3%		Striped bass	7.1%	

Table 9. (Continued)

Autumn 2015 Metric		CRM 4.4 Observations		Score	CRM 1.5 Observations		Score
8. Number of top carnivore species	Combined	**11**			**12**		
		Black crappie			Black crappie		
		Flathead catfish			Flathead catfish		
		Largemouth bass			Largemouth bass		
		Rock bass			Rock bass		
		Sauger			Sauger		
		Skipjack herring		**5**	Skipjack herring		**5**
		Smallmouth bass			Smallmouth bass		
		Spotted bass			Spotted bass		
		Walleye			Walleye		
		White bass			White bass		
		Yellow bass			White crappie		
					Yellow bass		
B. Trophic composition							
9. Percent top carnivores	Electrofishing	**10.0%**			**6.3%**		
		Black crappie	0.1%		Black crappie	0.1%	
		Flathead catfish	0.1%		Flathead catfish	<0.1%	
		Largemouth bass	8.5%	**1.5**	Largemouth bass	5.6%	**1.5**
		Sauger	0.1%		Smallmouth bass	0.4%	
		Smallmouth bass	0.8%		Striped bass	<0.1%	
		Spotted bass	0.4%		White bass	0.1%	
		White bass	0.1%		White crappie	<0.1%	
	Gill Netting	**48.5%**			**61.7%**		
		Black crappie	0.8%		Flathead catfish	1.4%	
		Flathead catfish	0.8%		Largemouth bass	0.7%	
		Largemouth bass	1.5%		Rock bass	0.7%	
		Rock bass	2.3%		Sauger	0.7%	
		Sauger	0.8%		Skipjack herring	15.6%	
		Skipjack herring	4.6%	**1.5**	Smallmouth bass	0.7%	**2.5**
		Striped bass	12.3%		Spotted bass	2.1%	
		Walleye	16.9%		Striped bass	7.1%	
		White bass	6.9%		Walleye	7.1%	
		Yellow bass	1.5%		White bass	21.3%	
					White crappie	0.7%	
					Yellow bass	3.5%	

Table 9. (Continued)

Autumn 2015 Metric		CRM 4.4 Observations		Score	CRM 1.5 Observations		Score
10. Percent omnivores	Electrofishing	**4.4%**			**9.0%**		
		Blue catfish	0.1%		Black buffalo	<0.1%	
		Bluntnose minnow	0.1%		Bluntnose minnow	0.1%	
		Channel catfish	0.5%	**2.5**	Channel catfish	0.5%	**2.5**
		Common carp	1.4%		Common carp	0.4%	
		Gizzard shad	2.1%		Gizzard shad	7.4%	
		Smallmouth buffalo	0.3%		Smallmouth buffalo	0.6%	
	Gill Netting	**36.2%**			**29.8%**		
		Blue catfish	8.5%		Blue catfish	9.2%	
		Channel catfish	6.2%		Channel catfish	3.5%	
		Common carp	1.5%	**1.5**	Common carp	2.1%	**1.5**
		Gizzard shad	13.8%		Gizzard shad	6.4%	
		Smallmouth buffalo	6.2%		Quillback	0.7%	
					Smallmouth buffalo	7.8%	
C. Fish abundance and health							
11. Average number per run	Electrofishing	**87.8**		**0.5**	**142.9**		**1.5**
	Gill Netting	**13.0**		**1.5**	**14.10**		**1.5**
12. Percent anomalies	Electrofishing	**0.2%**		**2.5**	**0.2%**		**2.5**
	Gill Netting	**0.0%**		**2.5**	**0.7%**		**2.5**
Overall RFAI Score				**43 Good**			**47 Good**

Table 10. Species collected, ecological and recreational designations, and corresponding electrofishing (EF) and gill net (GN) catch per unit effort in the Clinch River upstream (CRM 4.4) of Kingston Fossil Plant discharge – Autumn 2015

Common Name	Scientific name	Trophic level	Indigenous species	Tolerance	Thermally Sensitive Species	Comm. Valuable Species	Rec. Valuable Species	EF Catch Per Run	EF Catch Per Hour	Total Fish EF	GN Catch Per Net	Total Fish GN	Total fish Combined	Percent Composition
Gizzard shad	*Dorosoma cepedianum*	OM	X	TOL	.	X	X	1.80	6.67	27	1.80	18	45	3.11
Common carp*	*Cyprinus carpio*	OM	.	TOL	.	X	.	1.20	4.44	18	0.20	2	20	1.38
Spotfin shiner	*Cyprinella spiloptera*	IN	X	TOL	.	.	.	5.13	19.01	77	.	.	77	5.32
Bluntnose minnow	*Pimephales notatus*	OM	X	TOL	.	.	.	0.07	0.25	1	.	.	1	0.07
Green sunfish	*Lepomis cyanellus*	IN	X	TOL	.	.	X	0.13	0.49	2	.	.	2	0.14
Bluegill	*Lepomis macrochirus*	IN	X	TOL	.	.	X	35.93	133.09	539	0.10	1	540	37.32
Largemouth bass	*Micropterus salmoides*	TC	X	TOL	.	.	X	7.47	27.65	112	0.20	2	114	7.88
Skipjack herring	*Alosa chrysochloris*	TC	X	INT	.	X	.	.	.	.	0.60	6	6	0.41
Northern hog sucker	*Hypentelium nigricans*	BI	X	INT	.	.	.	0.33	1.23	5	.	.	5	0.35
Spotted sucker	*Minytrema melanops*	BI	X	INT	X	X	.	2.73	10.12	41	0.10	1	42	2.90
Black redhorse	*Moxostoma duquesnei*	BI	X	INT	.	.	.	0.20	0.74	3	0.20	2	5	0.35
Rock bass	*Ambloplites rupestris*	TC	X	INT	.	.	X	.	.	.	0.30	3	3	0.21
Longear sunfish	*Lepomis megalotis*	IN	X	INT	.	.	X	0.13	0.49	2	.	.	2	0.14
Smallmouth bass	*Micropterus dolomieu*	TC	X	INT	.	.	X	0.73	2.72	11	.	.	11	0.76
Brook silverside	*Labidesthes sicculus*	IN	X	INT	.	X	.	0.27	0.99	4	.	.	4	0.28
Lake sturgeon	*Acipenser fulvescens*	IN	X	.	.	.	X	.	.	.	0.30	3	3	0.21
Threadfin shad	*Dorosoma petenense*	PK	X	.	.	X	X	.	.	.	0.80	8	8	0.55
Smallmouth buffalo	*Ictiobus bubalus*	OM	X	.	.	X	.	0.27	0.99	4	0.80	8	12	0.83
Golden redhorse	*Moxostoma erythrurum*	BI	X	.	.	X	.	0.07	0.25	1	0.10	1	2	0.14
Blue catfish	*Ictalurus furcatus*	OM	X	.	.	X	X	0.07	0.25	1	1.10	11	12	0.83
Channel catfish	*Ictalurus punctatus*	OM	X	.	.	X	X	0.47	1.73	7	0.80	8	15	1.04
Flathead catfish	*Pylodictis olivaris*	TC	X	.	.	X	X	0.07	0.25	1	0.10	1	2	0.14
White bass	*Morone chrysops*	TC	X	.	.	.	X	0.07	0.25	1	0.90	9	10	0.69
Yellow bass	*Morone mississippiensis*	TC	X	.	.	X	X	.	.	.	0.20	2	2	0.14
Striped bass*	*Morone saxatilis*	TC	.	.	.	.	X	.	.	.	1.60	16	16	1.11
Warmouth	*Lepomis gulosus*	IN	X	.	.	.	X	0.07	0.25	1	.	.	1	0.07
Redear sunfish	*Lepomis microlophus*	IN	X	.	.	.	X	4.27	15.80	64	0.10	1	65	4.49
Hybrid sunfish	*Hybrid lepomis spp.*	IN	X	.	.	.	X	0.07	0.25	1	.	.	1	0.07
Spotted bass	*Micropterus punctulatus*	TC	X	.	.	.	X	0.33	1.23	5	.	.	5	0.35
Black crappie	*Pomoxis nigromaculatus*	TC	X	.	.	.	X	0.07	0.25	1	0.10	1	2	0.14
Greenside darter	*Etheostoma blennioides*	SP	X	.	X	.	.	0.07	0.25	1	.	.	1	0.07
Yellow perch*	*Perca flavescens*	IN	.	.	.	.	X	0.13	0.49	2	.	.	2	0.14
Logperch	*Percina caprodes*	BI	X	.	X	.	.	6.53	24.20	98	.	.	98	6.77
Sauger	*Sander canadense*	TC	X	.	.	.	X	0.07	0.25	1	0.10	1	2	0.14

Table 10. (CRM 4.4, Continued).

Common Name	Scientific name	Trophic level	Indigenous species	Tolerance	Thermally Sensitive Species	Comm. Valuable Species	Rec. Valuable Species	EF Catch Per Run	EF Catch Per Hour	Total Fish EF	GN Catch Per Net	Total Fish GN	Total fish Combined	Percent Composition
Walleye	*Sander vitreum*	TC	X	.	.	.	X	.	.	.	2.20	22	22	1.52
Freshwater drum	*Aplodinotus grunniens*	BI	X	.	.	X	.	0.07	0.25	1	0.30	3	4	0.28
Mississippi silverside*	*Menidia audens*	IN	.	.	.	X	.	18.93	70.12	284	.	.	284	19.63
Chestnut lamprey	*Ichthyomyzon castaneus*	PS	X	.	.	.	.	0.07	0.25	1	.	.	1	0.07
Total			**34**		**2**	**14**	**23**	**87.82**	**325.2**	**1,317**	**13**	**130**	**1,447**	**100.00**
Number of Samples								**15**			**10**			
Species Collected								**31**			**23**			

Trophic level: benthic invertivore (BI), insectivore (IN), omnivore (OM), top carnivore (TC); Tolerance: tolerant species (TOL), intolerant species (INT);
Comm.-Commercially, Rec.-Recreationally. An asterisk (*) next to the common name denotes an aquatic nuisance species. All species are considered representative important species.
No species collected have a Federal Threatened or Endangered status.

Table 11. Species collected, ecological and recreational designations, and corresponding electrofishing (EF) and gill net (GN) catch per unit effort in the Clinch River downstream (CRM 1.5) of Kingston Fossil Plant discharge – Autumn 2015

Common Name	Scientific name	Trophic level	Indigenous species	Tolerance	Thermally Sensitive Species	Comm. Valuable Species	Rec. Valuable Species	EF Catch Per Run	EF Catch Per Hour	Total Fish EF	GN Catch Per Net	Total Fish GN	Total fish Combined	Percent Composition
Gizzard shad	*Dorosoma cepedianum*	OM	X	TOL	.	X	X	10.60	41.19	159	0.90	9	168	7.35
Common carp*	*Cyprinus carpio*	OM	.	TOL	.	X	.	0.53	2.07	8	0.30	3	11	0.48
Spotfin shiner	*Cyprinella spiloptera*	IN	X	TOL	.	.	.	5.07	19.69	76	.	.	76	3.33
Bluntnose minnow	*Pimephales notatus*	OM	X	TOL	.	.	X	0.20	0.78	3	.	.	3	0.13
Redbreast sunfish*	*Lepomis auritus*	IN	.	TOL	.	.	X	0.20	0.78	3	.	.	3	0.13
Green sunfish	*Lepomis cyanellus*	IN	X	TOL	.	.	X	0.47	1.81	7	.	.	7	0.31
Bluegill	*Lepomis macrochirus*	IN	X	TOL	.	.	X	17.60	68.39	264	0.10	1	265	11.60
Largemouth bass	*Micropterus salmoides*	TC	X	TOL	.	.	X	8.07	31.35	121	0.10	1	122	5.34
White crappie	*Pomoxis annularis*	TC	X	TOL	.	.	X	0.07	0.26	1	0.10	1	2	0.09
Skipjack herring	*Alosa chrysochloris*	TC	X	INT	.	X	.	.	.	.	2.20	22	22	0.96
Northern hog sucker	*Hypentelium nigricans*	BI	X	INT	.	.	.	0.13	0.52	2	.	.	2	0.09
Spotted sucker	*Minytrema melanops*	BI	X	INT	X	X	.	0.67	2.59	10	.	.	10	0.44
Rock bass	*Ambloplites rupestris*	TC	X	INT	.	.	X	.	.	.	0.10	1	1	0.04
Longear sunfish	*Lepomis megalotis*	IN	X	INT	.	.	X	1.07	4.15	16	.	.	16	0.70
Smallmouth bass	*Micropterus dolomieu*	TC	X	INT	.	.	X	0.53	2.07	8	0.10	1	9	0.39
Brook silverside	*Labidesthes sicculus*	IN	X	INT	.	X	.	1.73	6.74	26	.	.	26	1.14
Lake sturgeon	*Acipenser fulvescens*	IN	X	.	.	.	.	.	.	.	0.10	1	1	0.04
Threadfin shad	*Dorosoma petenense*	PK	X	.	.	X	.	70.13	272.54	1052	0.10	1	1,053	46.08
Bullhead minnow	*Pimephales vigilax*	IN	X	.	.	.	.	0.47	1.81	7	.	.	7	0.31
Quillback	*Carpiodes cyprinus*	OM	X	.	.	.	.	.	.	.	0.10	1	1	0.04
Smallmouth buffalo	*Ictiobus bubalus*	OM	X	.	.	X	.	0.87	3.37	13	1.10	11	24	1.05
Black buffalo	*Ictiobus niger*	OM	X	.	.	.	.	0.07	0.26	1	.	.	1	0.04
Golden redhorse	*Moxostoma erythrurum*	BI	X	.	.	X	.	0.07	0.26	1	.	.	1	0.04
Blue catfish	*Ictalurus furcatus*	OM	X	.	.	X	X	.	.	.	1.30	13	13	0.57
Channel catfish	*Ictalurus punctatus*	OM	X	.	.	X	X	0.67	2.59	10	0.50	5	15	0.66
Flathead catfish	*Pylodictis olivaris*	TC	X	.	.	X	X	0.07	0.26	1	0.20	2	3	0.13
White bass	*Morone chrysops*	TC	X	.	.	.	X	0.13	0.52	2	3.00	30	32	1.40
Yellow bass	*Morone mississippiensis*	TC	X	.	.	.	.	.	.	.	0.50	5	5	0.22
Striped bass*	*Morone saxatilis*	TC	.	.	.	.	X	0.07	0.26	1	1.00	10	11	0.48
Warmouth	*Lepomis gulosus*	IN	X	.	.	.	X	0.13	0.52	2	.	.	2	0.09
Redear sunfish	*Lepomis microlophus*	IN	X	.	.	.	X	2.00	7.77	30	0.40	4	34	1.49
Spotted bass	*Micropterus punctulatus*	TC	X	.	.	.	X	0.00	0.00	.	0.30	3	3	0.13
Black crappie	*Pomoxis nigromaculatus*	TC	X	.	.	.	X	0.13	0.52	2	.	.	2	0.09
Greenside darter	*Etheostoma blennioides*	SP	X	.	.	.	.	0.07	0.26	1	.	.	1	0.04
Snubnose darter	*Etheostoma simoterum*	SP	X	.	.	.	.	0.13	0.52	2	.	.	2	0.09
Yellow perch*	*Perca flavescens*	IN	.	.	.	.	.	0.07	0.26	1	.	.	1	0.04

Table 11. (CRM 1.5, Continued).

Common Name	Scientific name	Trophic level	Indigenous species	Tolerance	Thermally Sensitive Species	Comm. Valuable Species	Rec. Valuable Species	EF Catch Per Run	EF Catch Per Hour	Total Fish EF	GN Catch Per Net	Total Fish GN	Total fish Combined	Percent Composition
Logperch	*Percina caprodes*	BI	X	.	X	.	.	3.47	13.47	52	.	.	52	2.28
Sauger	*Stizostedion canadense*	TC	X	.	.	.	X	.	.	.	0.10	1	1	0.04
Walleye	*Stizostedion vitreum*	TC	X	.	.	.	X	.	.	.	1.00	10	10	0.44
Freshwater drum	*Aplodinotus grunniens*	BI	X	.	.	X	.	0.20	0.78	3	0.50	5	8	0.35
Mississippi silverside*	*Menidia audens*	IN	.	.	.	X	.	17.27	67.10	259	.	.	259	11.33
Total			**36**		**2**	**16**	**23**	**142.96**	**555.46**	**2.144**	**14.1**	**141**	**2.285**	**100.00**
Number of Samples								**15**			**10**			
Species Collected								**32**			**23**			

Trophic level: benthic invertivore (BI), insectivore (IN), omnivore (OM), top carnivore (TC); Tolerance: tolerant species (TOL), intolerant species (INT); Comm.-Commercially, Rec.-Recreationally. An asterisk (*) next to the common name denotes an aquatic nuisance species. All species are considered representative important species. No species collected have a Federal Threatened or Endangered status.

Table 12. Fish species collected during sampling of the Reservoir Fish Assemblage Index sites upstream and downstream of Kingston Fossil Plant in Watts Bar Reservoir from 2001 through 2015

	CRM 4.4-US									CRM 1.5-DS								
Species	**2015**	**2013**	**2012**	**2011**	**2010**	**2007**	**2005**	**2003**	**2001**	**2015**	**2013**	**2012**	**2011**	**2010**	**2007**	**2005**	**2003**	**2001**
Longnose gar				X		X		X						X	X	X	X	
Gizzard shad	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Common carp*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Golden shiner						X		X	X								X	X
Spotfin shiner	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Striped shiner														X				
Bluntnose minnow	X	X	X		X	X		X	X	X	X	X	X	X	X	X	X	X
River carpsucker																		X
Redbreast sunfish*		X	X	X	X				X	X	X	X	X	X	X	X	X	X
Green sunfish	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Bluegill	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Largemouth bass	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Muskellunge				X														
White crappie					X		X	X	X	X		X	X	X		X	X	X
Skipjack herring	X	X	X		X		X	X	X	X		X		X		X	X	X
Northern hog sucker	X	X		X						X	X	X				X		
Spotted sucker	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X
Black redhorse	X	X	X	X	X	X	X	X	X		X	X	X					
Rock bass	X									X	X	X	X	X				
Longear sunfish	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Smallmouth bass	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Brook silverside	X	X			X	X	X	X	X	X	X	X		X	X	X	X	X
Lake sturgeon	X	X	X	X	X					X	X	X	X	X				
Paddlefish					X									X	X		X	X
Spotted gar		X	X		X			X			X			X	X	X	X	X
Threadfin shad	X	X	X	X		X		X	X	X	X	X	X	X		X	X	X
Mooneye								X								X	X	
Bullhead minnow				X		X				X	X							
Largescale stoneroller											X			X				
Steelcolor shiner											X	X				X		
River redhorse							X											
Emerald shiner							X		X								X	X
Quillback								X		X		X						
River carpsucker							X											
Smallmouth buffalo	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Table 12. (Continued)

	CRM 4.4-US									CRM 1.5-DS								
Species	**2015**	**2013**	**2012**	**2011**	**2010**	**2007**	**2005**	**2003**	**2001**	**2015**	**2013**	**2012**	**2011**	**2010**	**2007**	**2005**	**2003**	**2001**
Black buffalo		X		X	X		X	X	X	X		X		X		X		X
Silver redhorse		X					X											
Golden redhorse	X	X	X		X	X	X	X	X	X				X	X		X	
Blue catfish	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Channel catfish	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Flathead catfish	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
White bass	X			X	X	X	X	X	X	X		X	X	X	X	X	X	X
Yellow bass	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Striped bass*	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X
Hybrid striped x white							X											X
Warmouth	X	X	X	X	X			X	X	X	X	X	X					X
Redear sunfish	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Hybrid sunfish	X								X				X					
Spotted bass	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X
Hybrid bass		X			X													
Black crappie	X		X		X		X	X	X	X			X	X	X		X	X
Greenside darter	X									X								
Snubnose darter									X	X								
Redline darter		X																
Yellow perch*	X	X		X	X	X	X	X	X	X		X					X	X
Logperch	X	X			X	X	X	X	X	X	X	X		X		X	X	X
Sauger	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X
Walleye	X	X	X	X	X	X				X	X	X			X			
Freshwater drum	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Mississippi silverside*	X	X	X	X	X	X	X			X	X	X	X	X	X	X		
Chestnut lamprey	X				X									X				

Table 13. Summary of RFAI scores from areas located directly upstream and downstream of Kingston Fossil Plant during autumn 2015, compared to scores from sampling conducted during autumn 1993-2013 as part of the Reservoir Ecological Health Monitoring Program in Watts Bar Reservoir*

Site	Location	1993	1994	1996	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2015	Avg.
Clinch River Inflow	CRM 22	38	46	48	36	---	44	---	42	---	38	---	40	---	44	44	44	---	42	---	---	**42**
Tennessee River Inflow	TRM 601	38	50	42	46	---	46	---	46	---	44	---	50	---	46	44	48	---	48	---	---	**46**
Upstream of KIF	CRM 4.4	---	---	---	---	---	---	45	---	42	---	44	---	36	---	38	42	44	43	44	43	**42**
Downstream of KIF	CRM 1.5	---	---	---	---	---	---	42	---	44	---	41	---	34	---	36	42	36	41	41	47	**40**
Transition	TRM 560.8	50	47	44	44	---	46	---	39	---	46	---	40	---	38	36	42	---	41	---	---	**43**
Forebay	TRM 531	44	45	42	38	36	42	38	37	44	39	45	40	35	35	43	39	42	43	46	39	**41**

RFAI Score Range: 12-21 ("Very Poor"), 22-31 ("Poor"), 32-40 ("Fair"), 41-50 ("Good"), or 51-60 ("Excellent")
*Some scores have changed when compared to previous reports. Redbreast sunfish has been declared non-indigenous, which may have affected scores for metrics 1 and 7.

Table 14. Statistical comparisons of the fish community samples collected upstream and downstream of KIF during 2015

Parameter	Mean		Standard Deviation		t-test Statistic $^{\beta}$	z-test Statistic $^{\gamma}$	P-value	Significant Difference?
	Upstream (CURM 107)	Downstream (CURM 102)	Upstream (CURM 107)	Downstream (CURM 102)				
Species (per run)								
Total (species richness)	12.4	13.4	3.4	3.5	0.79	--	0.43	No
Benthic invertivores	2.9	1.7	1.0	1.0	--	-2.79	0.01	Yes
Insectivores	4.0	5.6	1.4	1.5	3.00	--	0.01	Yes
Omnivores	2.9	3.6	1.5	1.4	1.26	--	0.21	No
Top carnivores	4.2	4.0	2.3	2.1	-0.25	--	0.80	No
Non-indigenous	1.9	2.0	1.0	0.8	--	0.31	0.76	No
Tolerant	4.1	4.6	0.9	1.1	1.50	--	0.13	No
Intolerant	2.4	2.5	0.9	1.4	--	0.02	0.98	No
Thermally Sensitive	1.1	0.7	0.3	0.5	--	-2.50	0.01	Yes
CPUE (per run)								
Total	5.5	9.3	2.6	8.1	--	1.24	0.21	No
Benthic invertivores	0.7	0.4	0.5	0.3	--	-2.12	0.03	Yes
Insectivores	4.4	3.2	3.0	2.8	--	-1.53	0.12	No
Omnivores	0.6	1.2	0.5	1.2	--	1.14	0.25	No
Top carnivores	1.2	1.3	0.7	0.8	0.35	--	0.73	No
Non-indigenous	1.5	1.3	2.3	1.4	--	0.35	0.72	No
Tolerant	3.6	3.0	2.0	1.8	-0.87	--	0.38	No
Intolerant	0.4	0.5	0.3	0.3	--	0.43	0.66	No
Thermally Sensitive	0.4	0.2	0.5	0.2	--	-1.33	0.18	No
Simpson Diversity Index	7.1	7.3	2.9	3.1	0.83	--	0.22	No
Shannon Diversity Index	0.8	0.7	0.1	0.2	--	-0.12	0.90	No

β - Comparing two population means from normally distributed independent samples. $n_1=n_2=15$, degree of freedom=$n_1+n_2-2=28$, $\alpha=0.05$, $t_{\alpha/2}=2.048$. H_o: $\mu_1=\mu_2$; H_o rejected if $t>t_{\alpha/2}$.

γ - Non-parametric Wilcoxon Rank Sum test on large independent samples. $\alpha=0.05$, $z_{\alpha/2}=1.96$. H_o: two sampled populations have identical probability distributions. H_o rejected if $P<\alpha$ or $|z|>z_{\alpha/2}$.

Table 15. Comparison of RBI metric ratings and total scores for laboratory-processed samples collected upstream and downstream of Kingston Fossil Plant, Watts Bar Reservoir, autumn 2015

	Downstream CRM 1.5		Downstream CRM 2.2		Upstream CRM 3.75	
Metric	**Obs**	**Rating**	**Obs**	**Rating**	**Obs**	**Rating**
1. Average number of taxa	14	5	14.6	5	16.6	5
2. Proportion of samples with long-lived organisms	1	5	1	5	1	5
3. Average number of EPT taxa	1.4	3	1.5	5	1	3
4. Average proportion of oligochaete individuals	7.5	5	11.3	3	11	3
5. Average proportion of total abundance comprised by the two most abundant taxa	72.5	5	72.8	5	66.3	5
6. Average density excluding chironomids and oligochaetes	1495	5	1373.3	5	1681.7	5
7. Zero-samples – proportion of samples containing no organisms	0	5	0	5	0	5
Benthic Index Score		**33**		**33**		**31**
Ecological Health Rating		**Excellent**		**Excellent**		**Excellent**

Reservoir Benthic Index Scores: 7-12 ("Very Poor"), 13-18 ("Poor"), 19-23 ("Fair"), 24-29 ("Good"), 30-35 ("Excellent)

Table 16a. Mean density per square meter of benthic taxa collected downstream and upstream of Kingston Fossil Plant (KIF), autumn 2015. All taxa listed contributed to individual RBI metrics and total scores

Taxa	KIF Downstream CRM 1.5	KIF Downstream CRM 2.2	KIF Upstream CRM 3.75
ANNELIDA			
Hirudinea	2	---	---
Arhynchobdellida			
Erpobdellidae	2	---	---
Rhynchobdellida			
Glossiphoniidae	3	2	---
Actinobdella inequiannulata	3	3	8
Actinobdella sp.	---	2	---
Helobdella elongata	12	---	---
Helobdella stagnalis	50	65	55
Oligochaeta			
Haplotaxida			
Naididae			
Naidinae	---	---	3
Dero sp.	---	---	3
Tubificinae whc	3	23	63
Tubificinae wohc	163	138	150
Branchiura sowerbyi	---	37	7
Limnodrilus cervix	---	3	---
Limnodrilus hoffmeisteri	2	5	10
ARTHROPODA			
Crustacea			
Malacostraca			
Amphipoda			
Gammaridae			
Gammarus sp.	---	3	10
Hexapoda			
Insecta			
Diptera			
Ceratopogonidae	8	3	7
Chironomidae			
Ablabesmyia annulata	80	43	73
Chironomus sp.	62	10	90
Coelotanypus sp.	35	45	35
Cryptochironomus sp.	33	10	28
Cryptotendipes sp.	2	---	---

Table 16a. (Continued)

Taxa	KIF Downstream CRM 1.5	KIF Downstream CRM 2.2	KIF Upstream CRM 3.75
Dicrotendipes sp.	52	15	47
Epoicocladius flavens	3	10	13
Fissimentum sp.	5	32	---
Glyptotendipes sp.	20	---	---
Microchironomus sp.	---	---	2
Microtendipes pedellus gp.	2	---	8
Paralauterborniella nigrohalteralis	---	2	---
Parametriocnemus sp.	---	---	2
Polypedilum halterale gp.	8	23	28
Procladius sp.	47	43	83
Stictochironomus caffrarius gp.	17	33	12
Tanytarsus sp.	---	8	8
Ephemeroptera			
Ephemeridae			
Hexagenia sp. <10mm	683	697	427
Hexagenia sp. >10mm	257	183	117
Caenidae			
Caenis sp.	8	2	---
Megaloptera			
Sialidae			
Sialis sp.	---	---	2
Odonata			
Gomphidae			
Stylurus sp.	---	2	---
Trichoptera			
Leptoceridae			
Oecetis sp.	3	5	2
Polycentropodidae			
Cyrnellus fraternus	---	2	---
MOLLUSCA			
Bivalvia			
Unionoida			
Unionidae	---	5	---
Veneroida			
Corbiculidae			
Corbicula fluminea <10mm	55	123	35
Corbicula fluminea >10mm	20	27	20

Table 16a. (Continued)

Taxa	KIF Downstream CRM 1.5	KIF Downstream CRM 2.2	KIF Upstream CRM 3.75
Dreissenidae			
Dreissena polymorpha	3	2	3
Sphaeriidae	2	15	---
Musculium transversum	290	132	832
Pisidium sp.	---	15	15
Sphaerium sp.	---	2	---
Gastropoda			
Architaenioglossa			
Viviparidae			
Viviparus sp.	3	---	5
Neotaenioglossa			
Hydrobiidae	---	---	10
Amnicola limosa	3	20	73
Pleuroceridae			
Pleurocera canaliculata	10	2	5
NEMATODA	17	5	3
PLATYHELMINTHES			
Trepaxonemata			
Neoophora			
Planariidae			
Dugesia tigrina	---	---	5
Number of Samples	10	10	10
Mean-Density per meter²	1968	1797	2300
Taxa Richness	29	33	32
Sum of area sampled (meter²)	0.6	0.6	0.6

Table 16b. Mean density per square meter of benthic taxa collected but not included in individual RBI metrics or total scores for sites upstream and downstream of Kingston Fossil Plant, autumn 2015

Taxa	KIF Downstream CRM 1.5	KIF Downstream CRM 2.2	KIF Upstream CRM 3.75
ARTHROPODA			
Chelicerata			
Arachnida			
Trombidiformes			
Arrenuridae			
Arrenurus sp.	---	7	3
Krendowskiidae			
Krendowskia sp.	---	---	2
Limnesiidae			
Limnesia sp.	2	2	---
Unionicolidae			
Neumania sp.	---	5	13
Unionicola sp.	3	5	20
Crustacea			
Branchiopoda			
Diplostraca			
Sididae			
Sida crystallina	---	---	2
Maxillopoda			
Cyclopoida			
Cyclopidae			
Mesocyclops edax	25	72	43
Ostracoda			
Podocopida			
Candonidae			
Candona sp.	60	58	48
Hexapoda			
Insecta			
Diptera			
Chaoboridae			
Chaoborus punctipennis	27	43	10
Number of Samples	10	10	10
Mean-Density per meter²	117	192	142
Taxa Richness	7	7	8
Sum of area sampled (meter²)	0.6	0.6	0.6

Table 17. Wildlife observed along 2100 m transects parallel to the Clinch River shoreline, upstream and downstream of Kingston Fossil Plant, October 2015

October 2015							
Survey Site		**Birds**	**Obs.**	**Reptile/Amphibian**	**Obs.**	**Mammals**	**Obs.**
CRM 4.4 (US)	RDB	Pied-billed grebe	1	Map turtle	13	White-tailed deer	3
		Mockingbird	2	Slider	1		
		Redheaded woodpecker	1				
		American crow	17				
		American robin	1				
		Unspecified perching bird	2				
		Double-crested cormorant	28				
		Great blue heron	2				
		Wood duck	9				
		Mallard	2				
		Blue jay	19				
		Cardinal	2				
	LDB	Blue jay	5	Map turtle	9	Eastern grey squirrel	4
		American crow	7	Painted turtle	2		
		Great blue heron	1				
		Unspecified perching bird	2				
		Yellow-shafted flicker	1				
		Ring-billed gull	1				
		Canada goose	4				
		Carolina wren	4				
		Carolina chickadee	1				
		European starling	4				
CRM 1.5 (DS)	RDB	American crow	3	Map turtle	6		
		Turkey vulture	10	Redear turtle	1		
		Mockingbird	3				
		Carolina chickadee	3				
		Blue jay	3				
		Cliff swallow	10				
		Canada goose	8				
		Rock dove	120				
		Unspecified perching bird	5				
		European starling	3				
		Common grackle	2				
		Double-crested cormorant	2				
		American coot	1				
CRM 1.5 (DS)	LDB	Double-crested cormorant	63			Eastern grey squirrel	1
		Canada goose	10				
		Blue jay	17				
		Great blue heron	4				
		Carolina chickadee	1				
		Redheaded woodpecker	1				
		Downy woodpecker	1				
		Common grackle	1				
		Eastern phoebe	1				
		American crow	3				
		Mockingbird	4				

Table 18. Wildlife observed during visual surveys conducted upstream and downstream of Kingston Fossil Plant, 2011 through 2015

	CRM 4.4 RDB Observed				CRM 4.4 LDB Observed				CRM 1.5 RDB Observed				CRM 1.5 LDB Observed			
	2011	2012	2013	2015	2011	2012	2013	2015	2011	2012	2013	2015	2011	2012	2013	2015
Birds																
American coot	30		1			40			1			1	35	1		
American crow		3	12	17	12	6	4	7	2	5	1	3	2		4	3
American goldfinch															2	
American robin				1												
Belted kingfisher	1		1				1		1		1					
Black duck		7														
Black vulture							1				1					
Blue jay		1	3	19			3	5				3			1	17
Canada goose						9		4		6		8				10
Cardinal				2												
Carolina chickadee			5			2	1	1			4	3			2	1
Carolina wren								4								
Cliff swallow												10				
Common grackle												2				1
Domestic duck													1	1		
Domestic goose						1										
Double-crested cormorant		4	4	28							6	2			1	63
Downy woodpecker			2												1	1
Eastern bluebird						1									1	
Eastern kingbird										1						
Eastern phoebe			1													1
European starling								4				3				
Great blue heron	3	4	5	2	2	4	4	1	1	2	2		1	4	2	4
Little blue heron													1			
Mallard	1	6	1	2	6	4	8			1			2	22	2	
Mockingbird			4	2			7				1	3			1	4
Mourning Dove							2									
Osprey													1			
Pied-billed grebe				1							1			3		
Red-headed woodpecker				1												1
Red-tailed hawk			1													
Red-winged blackbird							6									
Ring-billed gull								1								
Rock dove									26	30		120		3	3	
Ruby-throated hummingbird		1														
Rufous-sided towhee							1									

Table 18 (continued).

	CRM 4.4 RDB Observed				CRM 4.4 LDB Observed				CRM 1.5 RDB Observed				CRM 1.5 LDB Observed			
	2011	2012	2013	2015	2011	2012	2013	2015	2011	2012	2013	2015	2011	2012	2013	2015
Turkey vulture											1	10		1		
Unspecified duck	8															
Unspecified perching bird	1	2	5	2		2	5	2			4	5			7	
Western kingbird															1	
Wood duck			1	9									2			
Yellow-shafted flicker			6					1								
Reptile/Amphibian																
Eastern spiny softshell turtle											1					
Common slider				1												
Map turtle			5	13			10	9			49	6			1	
Painted turtle								2			1					
Red-eared turtle												1				
Unspecified turtle									3							
Mammals																
Eastern grey squirrel	1	1				2	1	4					1		4	1
White-tailed deer				3			1									

Table 19. Water temperature (°F) depth profiles collected to determine the extent of the thermal plume from Kingston Fossil Plant during 2015

Depth (m)	Ambient-CRM 3.1					Discharge-CRM 2.6					*Below Discharge-CRM 1.5				
October 2015	10%	30%	50%	70%	90%	10%	30%	50%	70%	90%	10%	30%	50%	70%	90%
0.3	21.4	21.4	21.4	21.4	21.4	21.7	21.6	21.6	21.7	21.7	21.8	21.6	21.6	21.8	21.4
1.5	21.3	21.3	21.3	21.3	21.4	21.7	21.6	21.6	21.6	21.6	21.5	21.4	21.4	21.4	21.3
3	21.2	21.1	21.1	21.2	21.4	21.6	21.6	21.5	21.3		21.4	21.4	21.3	21.3	
4						21.5					21.1				
5		19.8	20.0	20.1			20.6	21.3				20.6	21.1	21.2	
7		18.8	18.6	18.4			19.0	19.3					18.9	19.1	
9		18.5	18.4	18.4			18.5	18.6					18.5	18.5	
10			18.4												
11							18.4	18.4					18.5	18.5	
12							18.4						18.5	18.5	

*No plume temperatures were detected.

Table 20. Water quality parameters collected along vertical depth profiles at transects within the RFAI sample reaches upstream and downstream of Kingston Fossil Plant during 2015

October, 2015	LDB						Mid-channel						RDB					
CRM 4.4	Depth	°C	°F	pH	Cond	DO	Depth	°C	°F	pH	Cond	DO	Depth	°C	°F	pH	Cond	DO
Upstream	0.3	19.2	66.6	7.6	244.9	10.5	0.3	19.8	67.6	7.9	245.6	11.2	0.3	19	66.8	8	248	11
Boundary	1	19.2	66.6	7.3	243.8	9.9	1.5	19.2	66.6	7.8	248.5	10.7	1.5	19	66.4	8	250	11
							3	18.7	65.7	7.5	257.1	9.7	3	19	66.2	8	252	10
							5	18.5	65.2	7.3	261.6	9.4	5	19	65.6	7	260	10
							7	18.3	65.0	7.2	263.4	9.0	5.8	19	65.5	7	261	10
							9	18.0	64.4	7.1	263.8	8.5						
							11.3	17.9	64.3	7.1	263.4	8.4						
Mid-station	0.3	20.3	68.5	8.0	221.5	10.8	0.3	20.2	68.4	8.0	217.5	10.8	0.3	20.0	68.0	7.5	227.0	10.5
	1.5	20.1	68.1	7.9	224.2	10.4	1.5	19.8	67.6	7.8	238.3	10.4						
	2.4	20.0	67.9	7.8	229.9	20.0	3	19.7	67.5	7.7	242.9	10.3						
							5	18.3	65.0	7.2	260.0	8.6						
							7	18.0	64.4	7.1	264.2	8.6						
							9	18.0	64.4	7.1	264.0	8.6						
							10	18.0	64.4	7.1	264.3	8.8						
Downstream	0.3	20.8	69.4	7.5	244.0	10.0	0.3	20.9	69.5	7.7	244.4	10.0	0.3	20.8	69.4	7.7	244.5	10.0
Boundary	1.5	20.5	68.8	7.3	245.0	10.0	1.5	20.8	69.5	7.6	244.3	9.9	1.5	20.8	69.4	7.7	244.7	9.9
							2.5	20.8	69.4	7.6	244.7	9.9	3	20.7	69.3	7.6	245.2	9.8
													3.8	20.7	69.3	7.6	245.5	9.7

Table 20. (Continued)

	LDB						Mid-channel						RDB					
CRM 1.5	**Depth**	**°C**	**°F**	**pH**	**Cond**	**DO**	**Depth**	**°C**	**°F**	**pH**	**Cond**	**DO**	**Depth**	**°C**	**°F**	**pH**	**Cond**	**DO**
Upstream	0.3	21.6	70.9	7.5	257.9	8.9	0.3	21.5	70.7	7.8	244.7	10.0	0.3	21.5	70.8	7.8	251.6	9.8
Boundary	1.5	21.6	70.8	7.5	258.6	9.0	1.5	21.5	70.6	7.8	245.4	9.9	1.5	21.5	70.7	7.7	254.7	9.7
	2.4	21.6	70.8	7.5	257.5	9.0	3	21.4	70.5	7.7	248.6	9.6	3	21.5	70.6	7.7	258.0	9.5
							5	21.1	69.9	7.7	257.9	9.5	5	21.0	69.8	7.6	261.2	9.4
							5.9	20.9	69.6	7.6	255.4	9.4	7	19.3	66.7	7.5	273.0	9.3
													9	18.7	65.7	7.4	279.0	9.1
													10	18.5	65.3	7.4	280.7	8.9
													12	18.4	65.2	7.4	280.8	8.9
Mid-station	0.3	21.4	70.5	7.8	205.2	8.8	0.3	21.5	70.7	7.8	217.0	9.2	0.3	21.4	70.5	7.7	226.1	9.3
	1.5	21.4	70.5	7.7	205.4	8.8	1.5	21.3	70.3	7.7	212.5	8.9	1.5	21.3	70.4	7.6	225.6	9.2
							3	21.2	70.2	7.6	207.3	8.6	3	21.2	70.2	7.5	226.1	8.9
							5	20.8	69.5	7.5	210.6	8.8	5	20.9	69.7	7.4	236.5	8.9
							7	18.8	65.9	7.2	274.9	9.2	7	19.4	66.9	7.2	270.0	9.0
							9	18.6	65.5	7.4	279.5	8.9	8	19.0	66.1	7.1	275.6	9.0
							11	18.5	65.4	7.4	280.8	8.8						
Downstream	0.3	21.7	71.0	7.3	173.8	7.5	0.3	21.6	70.9	7.4	179.8	7.3	0.3	21.5	70.7	7.5	175.7	7.6
Boundary	1.5	21.5	70.8	7.2	174.8	7.5	1.5	21.5	70.8	7.3	179.7	7.2	1.5	21.3	70.4	7.5	176.7	7.4
							3	21.5	70.8	7.3	180.3	7.3	3	21.3	70.3	7.5	181.8	7.5

Abbreviations: °C – Temperature (degrees Celsius), °F – Temperature (degrees Fahrenheit), Cond – Conductivity, DO – Dissolved Oxygen

ATTACHMENT C

KINGSTON FOSSIL PLANT

Public Notice and Fact Sheet/Rationale
Thermal Discharges

The thermal component of the Kingston Fossil Plant condenser cooling water discharge is subject to compliance with Tennessee Water Quality Standards. Section 1200-4-.03 of the Tennessee Water Quality Standards provides that heated water discharges shall not cause the maximum receiving water temperature to exceed 3°C relative to an upstream control point nor to exceed 30.5°C. This section also provides that the maximum rate of water temperature change shall not exceed 2°C per hour. Section 1200-3-.04 of the Tennessee Water Quality Standards provides for a mixing zone defined as that section of a flowing stream or impounded waters in the immediate vicinity of an outfall where an effluent becomes dispersed and mixed. Such zones must be restricted in area and length and must neither prevent the free passage of fish, cause aquatic life mortality in the receiving waters, nor adversely affect nursery and spawning areas.

Notwithstanding these requirements, Section 316(a) of the Clean Water Act (the Act) allows the permitting authority to impose alternative and less stringent thermal limitations after demonstration that the water quality standards limitations are more stringent than necessary to ensure the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in and on the receiving water. In addition, Section 316(b) of the Act requires that the location, design, construction, and capacity of a cooling water intake structure reflect the best technology available for minimizing environmental impacts.

As a part of permitting activities on the previous NPDES permit, TVA provided information to support its request that a daily maximum condenser cooling water discharge temperature limitation of 36.1°C (97°F) be allowed under Section 316(a) of the Act. A determination was made on April 30, 1976, that the permittee had submitted adequate information to demonstrate that such alternative limitations on the thermal component of the Kingston Fossil Plant condenser cooling water discharge will ensure the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in and on the Watts Bar Reservoir of the Tennessee, Clinch, and Emory Rivers.

The above determination was based upon a review of the results of Watts Bar Reservoir biological studies which TVA conducted in the vicinity of Kingston Fossil Plant from June 1973 through September 1975. These studies consisted of an examination of the phytoplankton, periphyton, zooplankton, benthic macroinvertebrate, aquatic macrophyte, and fish communities. The fish studies consisted of gill netting, shoreline seining, electrofishing, and an examination of cove rotenone data collected over a 20-year period to assess fish passage, abundance, reproduction, length-weight relationships, and growth.

TVA's investigations demonstrated that the amount of desirable habitat for benthic organisms is limited in the vicinity of Kingston Fossil Plant because of the bottom contour of the reservoir, but that available

habitat is colonized by diverse communities of benthic organism. No unusual distribution of the abundant zooplankton fauna was found to exist because of Kingston thermal discharges, and no significant change in zooplankton biomass was found in the thermally influenced area. Phytoplankton communities were found to be dominated by diatoms and green algae, and blue-green algae were never present in nuisance levels. All species of fish present before the plant became operable were present in the 1974 sampling period, the diversity of the fish community was found to be adequate, and young-of-the-year fish data suggested that fish reproduction is adequate.

On May 31, 1989, as part of its application for reissuance of the NPDES permit, TVA requested that the Section 316(a) variance be continued. To support its request, TVA has stated that no significant change in the operation of the Kingston Fossil Plant has occurred which would increase the quantity or degree of heated water discharged to Watts Bar Reservoir. In addition, TVA has stated that to the best of its knowledge, no significant change has occurred to the aquatic biological community of Watts Bar Reservoir (Tennessee, Clinch, and Emory Rivers) in the vicinity of the Kingston Fossil Plant outfall. Based on the above factors and information, a tentative determination has been made that continuation of the 316(a) variance is appropriate in the reissuance of this permit.

On November 10, 1977, a determination was also made in accordance with Section 316(b) of the Act that the location, design, construction, and capacity of the Kingston Fossil Plant cooling water intake structure reflects the best technology available for minimizing adverse environmental impacts. This determination was based on the results of impingement and entrainment studies conducted by TVA during 1974-1975. Therefore, it has been tentatively determined that the condenser cooling water intake structure continues to reflect the best technology available, and no required changes to the intake are proposed at this time.

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